THE

ELECTRICAL REVIEW.

VOL. XLIII. OCTOBER 28, 1898. No. 1,092.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1898

Edition

Price 6s.

H. ALABASTER, GATEHOUSE & CO.,

4, LUDGATE HILL, LONDON E.C.

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Published every FRIDAY, Price 4d.

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Telegraphic Address: "AGENKAY, LONDON." Code A B C.

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THE STEAM TURBINE.

CONSIDERABLE attention is being accorded to the Parsons steam turbine in America. *Modern Machinery* has an appreciative article upon it in its series on types of rotary motors. The De Laval turbine is first described. Practically the De Laval steam turbine is a steam Pelton wheel, in which steam expanded in a nozzle is directed against curved vanes, makes one impact and escapes. Obviously, if steam escapes at, say, 2,000 feet per second, the rim of the wheel should run at about one half this speed. With a wheel of 8 inches diameter and a speed of 400 per second, the rim velocity will be about 800 feet per second, so that speeds are being attained which approximate to the theoretical.

As is well known, this turbine consists of a disc on a light spindle, the whole being allowed to find its own centre of revolution. Very high steam pressures are employed, no less that 1,735 lbs. per square inch, at which pressure steam has a temperature of 660° F. This steam is generated in a single tube boiler, the tube being very long and bent into spirals. There is a forced draft and automatic regulation to prevent over pressure. The turbine disc is really double, with a division wall. Steam impinges on one wheel, passes through the wall, and then impinges on the other. In the 100-H.P. turbine the revolutions are 13,000, and in the 50-H.P. size 16,400 per minute. The whole combination of boiler, dynamo and 100-H.P. turbine only occupies 19 feet 7 inches × 11 feet 5 inches, and the boiler generates 1,765 lbs. of steam per hour. It is 4 feet 6 inches diameter, and 9 feet 8 inches high.

The boiler tube is very small, and is found to be capable of bursting innocuously.

The Parsons turbine is different. It consists of a series of inward and outward flow wheels, with intermediate guide blades, the steam passing from one to another in its passage from end to end of the system. As the steam expands in its passage through the wheel, the diameter of the turbine increases. There are thus three different diameters: first, a considerable length of small diameter, then a smaller length, a little larger, and a still shorter length larger still. Correctly speaking, every succeeding disc should be a little larger than the preceding disc, but this would entail heavy cost of manufacture, and, as in compound engines, there is a wide margin for cylinder ratios, so in the turbine there is no practical necessity to exactly proportion each wheel to the pressure at that point, so that the steam flow may be everywhere of the same velocity. The advantage of the Parsons turbine is, that it can be run condensing. Recent trials have shown an electrical H.P. for 32·22 lbs. of steam when exhausting to the atmosphere, but with steam superheated to 30° F. the consumption was 30·97. With condenser, and a 25-inch vacuum, the consumption fell to only 19·51, which is excellen showing for a new invention, but one which we hope and fully believe the future will see improved upon.

D

As a means of using steam, the Parsons turbine is thermally correct, for it is everywhere identical in temperature with the steam flowing through it at every point. Initial condensation does not exist within it, and there is no re-evaporation. At once disappear the great thermal losses of the reciprocating engine, and at once, also, ought to disappear all attempts to make rotary engines of the piston type. We are not quite clear where the loss of efficiency occurs in the steam turbine whereby it is not so efficient as the best reciprocating engines. A good deal of friction can be supposed internally, but any steam flow friction can only reappear as heat, and go back at once into the steam. We should imagine that there must still be a considerable residual velocity in the escaping steam.

It is not necessary that a turbine consist of one machine. There may be several machines on different shafts, placed in series, and taking steam just as the cylinders of compound engines; and in this way multiple propellers may be run, and, moreover, any machine may be cut out of the series at will and run idle without serious friction loss due to its resistance. A peculiar feature is the shaft bearings. These are of ordinary form, but carried in a series of concentric sleeves fitting loosely in one another. Oil has free access to them, and fills the narrow spaces between them. The oil does not readily move out, being held by capillarity, but it allows a certain movement, and prevents vibration, giving an effect equal to elasticity.

It is not to be wondered at that with this admirable invention much time has been spent in perfecting it, and it is satisfactory to find this was properly recognised by the Patent Office in an extension of the Parsons patent.

The steam turbine undoubtedly contains within it the power and potency of competing with other high speed engines in the field. It has not been inaptly stated that the reciprocating or piston engine is an erroneously designed affair, in that it is an attempt to use the energy of a fluid capable of travelling 10 miles a minute by means of a piston which only moves about 600 feet per minute. The piston engine, in fact, resembles the use of the large overshot water-wheel under a high fall. Water powers of 3,000 feet have been utilised by the jet turbine or Pelton wheel. The largest overshot water-wheel ever made can only use a fall of about 70 feet. This is the size of the famous wheel at Laxey, in the Isle of Man. It only does a few horse-power of work, less than can be done by a high fall with a turbine that one could carry in one hand. Similarly, rapid flowing steam is to be utilised upon a rapidly-moving turbine. But it is not merely in a mechanical sense that steam is wrongly applied to slow-moving pistons. Steam suffers far more by contact with metal surfaces of varying temperature, and the evils of an initially cold cylinder are so serious that the benefits arising from expansion of the working fluid are very quickly countervailed by the pernicious condensation losses. The fact that the most economical engines are still of the old type, only shows how much room there is still for improvement in the turbine. The process may be long and difficult, but already the turbine is a success, and has so many and such positive advantages in a mechanical sense, that it has won for itself a place from which it will not readily be disturbed. Moreover, it has pointed out a possible direction in which the explosive powers of gaseous mixtures may, perhaps, be utilised in the near future without the necessity of water-cooling jackets.

The steam turbine, in fine, may be classed amongst the best examples of direct conversion of energy.

Tariff Notes.

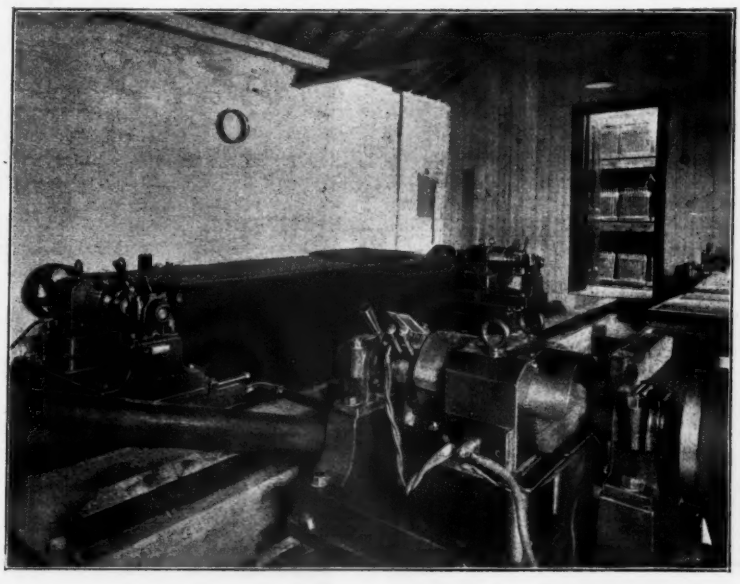
The Americans are said to be a humorous people. Perhaps this is why they cannot always perceive the exceedingly humorous nature of their serious moods. The editor of the *American Machinist*, however, does seem to be a little more wide awake. He has a correspondent in France who writes in a most strenuous manner about American trade with France, and is particularly wrathful that American machinery imported into France has to pay from 10 to 30 per cent. more duty than machinery sent from England or from Germany. Cannot, he plaintively asks, our diplomats manage to get us at least equal rights? Evidently he means to be serious, and he also really appears to think that America is being hardly dealt by. Now for facts. French machinery imported into England pays several thousand million per cent. less duty than French machinery imported into America. We are not quite sure that the above is a correct way of comparing no duty at all in England with the ridiculously high American tariff. Yet this American in Paris thinks that America ought to receive equal treatment with a no tariff England or a low tariff Germany. The editor, however, has more sense. Mr. Miller has travelled and seen something of England and of Europe, and states plainly that what has been food for the European goose must not be grumbled at when forced down the neck of the American gander. His correspondent, however, is very sore with the French, who "seem to be doing all they can to get their Government to raise the duty," and so on; in fact, who are mildly following American precedent, at a long distance, however. What strikes an outsider, however, as very funny indeed, is the loud boasting of the American, that his machinery can compete in Europe against, of course, the traditional pauper labour thereof, and at the same time the constant cry in the United States for tariffs to shut out of the country the very productions against which the American product can compete outside America some three or four thousand miles away. No doubt the real truth is somewhere in between. It pays Americans to manufacture a dozen articles if they can sell 10 at home behind a wall of tariffs and can send the other two abroad to be sold cheap. The tariff is put on to the price to the home consumer, and in this way the American manufacturer is really compelling his countrymen to pay a bounty on exported machinery. We English have never thought it worth while for many years to interfere with bounties and tariffs when such bounties have been thus indirect, though if foreigners try our patience much longer, it is possible they may require to be nudged up a bit with an occasional countervailing duty, as on sugar, for example. The *American Machinist* thinks that some glimmer of sense—*new light* is the term used—is breaking upon American machinery makers as to the tariffs, and puts forward the argument that machinery which can compete abroad needs no protection at home. This, however, while no doubt true in fact, is not a sound argument, as we have above shown. For years, American machinery and other products have been purchaseable in England at very much lower prices than they have been sold at in America. We could give instances, but those before us would be too obviously traced. A good deal is done in the way of discounts from list prices, but we have no doubt that in many lines competition has been helped by tariffs at home, acting as a bounty while there can also be little doubt that profits in some cases are enormous under the protection of the tariff, the home consumer paying very stiffly compared with what he would do at ordinary profit rates. The *Machinist* is evidently of opinion that high tariffs are doomed, irrespective of the classic pauperism in Europe.

THEATRE LIGHTING.

A large installation has recently been put into the New Palace Theatre just erected at Plymouth. The architectural features of the building have been most elaborately treated. Doulton ware being used throughout. The electric lighting arrangements are exceedingly effective, and a brief description will be of interest. The installation consists of some 1,200 incandescent lamps and six Jandus arc lamps.

The plant is erected in buildings adjoining the theatre, near the stage end. Space has been limited, and the contractors, Messrs. Veale and Co., Limited, have experienced considerable difficulty in laying out the plant, as shown in our photographs. The ground space available was 30 feet long by 14 feet wide. On the ground floor are fixed four 25—30 brake horse-power gas engines, made by the Campbell Gas Engine Company, of Halifax. These engines have been specially designed for the driving of dynamos, with governors actuated direct from the crank-shaft. Each engine has one fly-wheel only, weighing about 2 tons, and measuring 6 feet 6 inches in diameter. The engines are all arranged with their fly-wheels nearest the walls of engine room, to allow plenty of room for the man controlling the plant. Each engine is fitted with one of Edmondson and Dawson's patent self-starters. All the four engines can be got up to full speed within a quarter of an hour. The cooling of the cylinders is done from three rectangular water tanks having a total capacity of 3,600 gallons; a large main feed to the engines and one common return, to which each engine is connected, ensure a perfect cooling arrangement. The difficulty of space has been well got over in the arrangement of the tanks. The exhaust of each engine is carried to the top of the theatre roof, about 60 feet high, with a 3½-inch pipe, and passed through an exhaust box and silencer, the noise from the exhaust being effectually silenced.

The Staircase Lights.



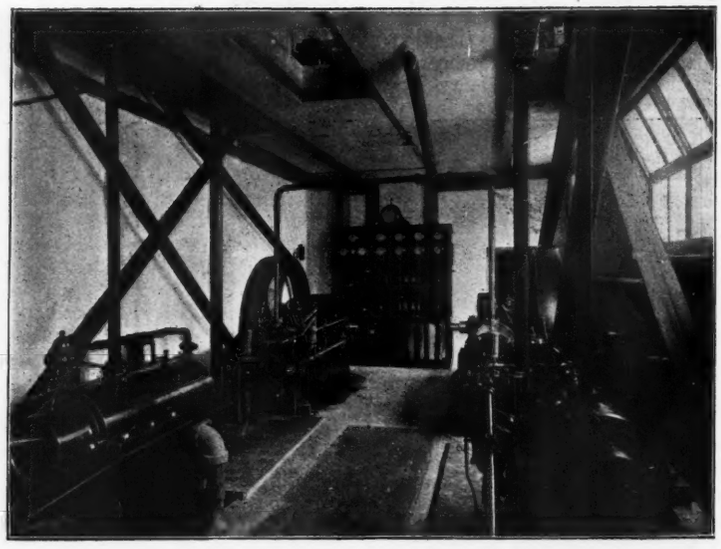
Dynamo Room.

These engines drive four shunt-wound dynamos erected on the first floor immediately over the engine room, the arrangement of cross driving allowing 18 feet between engine and dynamo centres. The dynamos are driven by special laminated leather belting of Hendry's manufacture. The dynamos were manufactured by Messrs. Veale & Co., Limited, at St. Austell. Three are wound for an output of 145 amperes at 110 volts, and the fourth for 100 amperes at 150 volts. Each machine is connected to a specially constructed switchboard in the engine room, as shown in the illustrations. Each dynamo has its own panel containing voltmeter, ammeter, automatic cut-out, main switch and fuse, and pilot lamp. A pair of common bus bars are provided, to which the four dynamos can be connected for running in parallel. The fourth dynamo has a special switch arrangement for either running direct on to the bus bars or for charging a set of 60 chloride R 19 cells which are erected on the first floor. The battery is generally charged in the day time and discharged in the evenings on to the bus bar of the main switchboard which supplies the current to the theatre. Two pairs of large mains carry the current from the main engine room to the stage switchboard, which is erected on the prompt side of the stage about 10 feet from the floor on a specially-constructed platform. The stage board is divided into two halves, which can be connected together when desired by a parallel switch. From this board the lighting is divided into four sections:—No. 1, stage; No. 2, auditorium; No. 3, front of house; No. 4, Great Western Hotel (a hotel adjoining the premises). Each section is controlled by specially-designed and constructed distribution boards manufactured by the Sheffield Electric Light and Power Company and the Edison & Swan United Company.

The stage lighting is very complete. Proscenium, floats, battens, side lengths, floor lengths, stage arcs, and all accessory lights being ably controlled from the stage board. Liquid resistances are employed for giving the necessary stage effects. The auditorium has been most effectually treated, the large dome in the ceiling being lighted from a ring of 100 incandescent lamps hidden behind a specially designed moulding, this dome, with beautifully painted canvas, depicts England's naval strength, ancient and modern, and produces a most charming effect, shadows being entirely absent on the pictures. From the corners of the ceiling are suspended four handsome electroliers of the "flambo" design, manufac-

tured by Messrs. Veritys, Limited, giving 550 candle-power each.

The balcony and gallery fronts are fitted with special brackets, two lights each, in keeping with the electroliers on the ceiling. The circle and refreshment bars contain ornamental fittings. A special feature in the auditorium is the electric turn-locks, fitted one on each side of the private boxes. These can be seen from any part of the house, and indicate, by means of an illuminated number, the next event of the programme. The block is controlled from a special switch on the stage, and dispenses with the services of the two call boys usually employed in music halls for number changing. The arrangement of the clock is that of Mr. Arber, the architect, and was fitted by the contractors.



Engine Room.

The whole of the electric lighting has been successfully carried out by Messrs. Veale & Co., Limited, of St. Austell and Plymouth, under the personal direction of Mr. C. Furness, A.M.I.M.E., A.I.E.E., their district manager and engineer.

Mr. Furness has had considerable experience in theatre and music hall lighting.

The average load of the installation is 500 amperes per hour for 4 hours at 110 volts $\therefore 55 \times 4 = 220$ units per night; $220 \times 6 = 1{,}320$ units per week. The gas for the 4 25-B.H.P. engines passes through a 400-light meter; the gas consumption per night averages 7,000 cubic feet and the Plymouth Gas Company's charge is at the rate of 1s. 9d. per 1,000; 7,000 at 1s. 9d. per 1,000 = 12s. 3d. per night, or £3 13s. 6d. per week.

The cost of production is therefore:—

	£	s.	d.
42,000 cubic feet of gas at 1s. 9d. per 1,000 ...	3	13	6
One engine man's attendance at £1 5s. 6d. per week	1	5	6
One dynamo attendant at £1 2s. 6d. per week ...	1	2	6
Oil, waste and engine sundries	0	12	6
For 1,320 units	£6	14	0

$$\frac{1{,}608}{1{,}320} = 1{\cdot}22 \text{ pence per unit.}$$

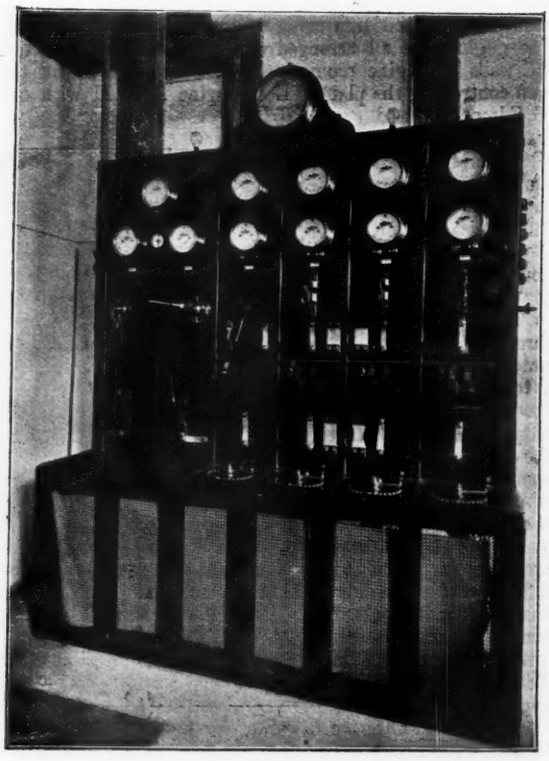
There are, of course, to be taken into consideration, repairs, &c. The renewal of the battery at the end of five years, if necessary, would mean a cost of £300; this means the laying aside of £60 per annum, or £1 3s. per week, and for repairs to plant £1 per week. Proportioning this amount over the units consumed $\frac{516}{1{,}320} = 0{\cdot}39$ of a penny per unit. Summary of works' cost per B.T.U. is gas, wages, oil, waste, 1·3d., renewals and repairs, 0·39d. = 1·69d. per unit.

It is expected that the arrangement will be a very economical one.

COMMON BATTERY SYSTEM FOR THE CHICAGO TELEPHONE EXCHANGE.*

The common battery system of telephone exchange operation, as developed by the Bell Companies, is now without doubt perfected to an extent where it will probably be only a matter of months and years until this system is installed to operate all the larger and many of the smaller Bell exchanges. The removal of all batteries, magneto-generators, and troublesome appliances from the subscribers' instruments, and the supplying of all the electrical work from a common battery at the exchange, is certainly an object that is worth spending considerable money in re-equipment to attain. The Bell common battery system has been standardised to a large extent, so that engineering difficulties are nearly weeded out.

The Chicago Telephone Company is putting in a new exchange station on the second floor of the Title and Trust Building, 100, Washington Street, and in this installation, which is to be known as "Central," the common battery system will be used. It is understood that the "Express" telephones of this company's exchange will be changed on to this new common battery system, and new telephones in the heart of the city will be put on it also.



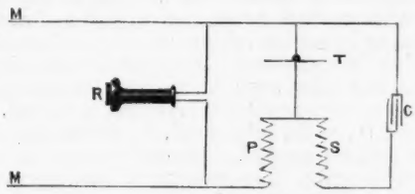
Theatre Lighting: Main Switchboard.

The standard adopted by the Bell Companies for common battery work is a 24-volt bank of storage cells charged by motor generators. From this 24-volt circuit the miniature signal lamps are operated and transmitters supplied.

As the arrangement of circuits for the transmitter in the

* New York *Electrical Engineer*.

Bell common battery system may not be familiar to some of our readers, we show a diagram of the circuits in the accompanying engraving. M M are the main wires from the central office, R is the receiver bridged across the mains, T is the transmitter, S and P are the primary and secondary coils of a transmitter coil connected in as indicated, and C is a condenser. S and P are so connected relatively to each other that the charge and discharge of the condenser with the voice currents tends to magnify the vibrations in the main transmitter circuit leading to the central office. Thus, when the resistance of the transmitter decreases, the increased flow



of current through the primary tends to make a current flow through the secondary to charge the condenser, and this in turn increases the current in the primary, and consequently in the main line wires. Then, when the resistance of the transmitter increases, the primary, acting on the secondary, tends to help the condenser discharge through the transmitter and oppose the voltage from the central office, thereby cutting down the current in the line wire. Thus, both the rises and falls in the transmitter circuit current are magnified by this beautiful and ingenious arrangement, and the working of transmitters from a central office current supply is made practicable under all conditions arising in ordinary practice.

REVIEW.

The Storage Battery: A Practical Treatise on the Construction, Theory, and Use of Secondary Batteries. By Augustus Treadwell, Jun., E.E., Associate Member A.I.E.E. London: Whittaker & Co.

This book of 257 pages may claim to be the most important work on storage batteries—in the English language at least—that has hitherto appeared. It is true that a number of its pages are filled with non-critical descriptions of more or less obsolete plates and batteries, but, on the other hand, much useful information has been collected from widely distributed sources, and presented in a readable and available form. In his preface the author states that he found himself hampered in his work by the lack of compact data relating to the construction of secondary cells, and by the paucity of what are termed "reliable" discharge curves. A considerable number of curves of charge as well as discharge are given in the work, and these are no doubt trustworthy so far as the information they convey extends. Most of them, however, are volt-hour curves, which are absolutely useless in the absence of data as to amperes, watts, and pounds avoirdupois, which in the present work, as elsewhere, are frequently not forthcoming. At page 68 an illustration is given of curves, showing the percentage of PbO_2 in the peroxide active material at varying periods both during the charge and the discharge. At page 72 are given a series of curves, showing the apparent or actual increase of capacity with time of discharge; but we fail to find any reference to those curves in the body of the work, so that their exact signification is a matter of conjecture. The curves shown at page 84, in connection with the Gülcher woven-plate battery, seem curiously unsatisfactory; the initial voltage of the charging current being about 2, rising to 2·7 in 4½ hours, whilst the initial voltage of discharge is about 1·94, falling to 1·8 in less than 4½ hours. In this case we are informed that the charging current was constant at 7·4 amperes, that the discharge was effected through a constant resistance, and that the average discharge current was 7·58 amperes. All this might be of some interest if we knew the weight of the plates, or the total weight of the cell. The curves shown at page 87 are curious and questionable; they relate to the Haschke battery, to which the same adjectives may be applied. The curve, A, indicates the discharge voltage of a 250-ampere-hour cell over a period of 10 hours; the initial voltage being 2·6, and the final 1·7. The curve, B, shows the discharge voltage of a 100-ampere-hour cell, extending over a period of 7 *minutes*, the initial voltage being slightly under 2·6, and the final 1·5 The curve, C, also applies to a 100-ampere-hour cell, it gives the voltage over a period of 9 *seconds*, employed in burning a ¾-inch hole through a 2-inch sheet of steel. The initial voltage is 2·7 and the final 1·5. No explanation is given as to the *modus generandi* of these enormous initial voltages. The active materials are the ordinary peroxide and spongy lead, and, apparently, the only peculiar feature in the construction of the battery is the insulating (? separating) medium, which we are told is a specially-prepared cardboard, subjected to an electro-chemical process. "Certain chemicals, the composition of which is a secret, are decomposed by electrolysis in a containing vat, and the gases therefrom rise and saturate the insulation. A current of 35 amperes at 20 volts is used to vaporise or treat 45 sheets of this cardboard, each sheet being 26 inches × 26 inches."

The curves on page 101 will, we fear, prove a sore trial to the conscientious student of Mr. Treadwell's book. In this case, volts, amperes, period of discharge, weight of plates, and weight of cell are all given. These curves relate to a discharge of the "River and Rail" accumulator patented by Messrs. Main & Meserole. In this the "positive electrode" consists of a number of thin lead plates fastened by lead rivets to thicker outside lead plates, all the plates being perforated with a number of small holes. In "forming," the compound plate is the anode in an electrolyte consisting of a solution of zinc and mercuric sulphates. The negative electrode (in charging) is a copper plate bent in U form, within which the peroxide plate is suspended, contact being prevented by "a hard rubber ring." In charging, the copper becomes coated with a zinc amalgam. The battery from which the curves of discharge were taken consisted of 14 plates; and from internal evidence—for the fact is not mentioned—we arrive at the conclusion that it was composed of seven couples in series. We are told that it was built especially for traction purposes, and weighed 45 lbs. The curves show that the initial P.D. per cell was 2·13 volts—which is very low for a zinc-peroxide couple—and that the final P.D., after a 12-hour discharge, was 1·48—a voltage which indicates that the battery was very much over-discharged. The mean current for 10 hours—in which period the voltage per cell had fallen to 1·8—was 2·24 amperes. The mean ratio of amperes to gross weight of cell in pounds, is thus not quite ·36, or about equal to that of an E.P.S. "K" cell. Taking the 10-hour discharge, the ratio of ampere-hours to gross weight of one cell is thus 3·6. The mean P.D. over the 10 hours being close upon 2 volts, the ratio of watt-hours to gross weight would be 7·2, *i.e.*, it is not much higher than that obtained with the E.P.S. "K" cell. Thus the curves in question condemn the battery for traction purposes.

In regard to the use of accumulators in central stations and sub-stations for the distribution of electric light and power, there is, in Mr. Treadwell's introduction to his book, an interesting summing up of the conclusions arrived at by electrical engineers in America, which shows that the value of the storage battery is becoming more and more recognised. According to a paper by Mr. C. L. Edgar, published in the *Transactions* of the A.I.E.E., the uses of accumulators for central station purposes may be classed under four principal heads, viz.:—

1. To carry the "peak of the load," viz., the additional power which is in demand during two or three hours only in the day.
2. To carry the entire load at minimum hours.
3. To act as equaliser or reservoir.
4. For the equipment of annex or sub-stations.

It is stated that the peak of the load in the majority of stations represents from one-third to one-half the total maximum load. The use of accumulators for carrying the entire load at minimum hours is generally condemned in America, on the ground that the period of minimum load is too short to warrant laying off a shift of men, or to render it economical to bank or draw the fires.

"Miller claims that when accumulators are used for equalising the load, at least 15 per cent. per year is saved in fuel. By the use of accumulators in the station of the Boston Edison Illuminating Company, the load on the engines is never less than three-fourths of the maximum. In this case the battery, costing $50,000, was used instead of a steam engine and dynamo of the same capacity, costing $65,000. One of the first railway plants to use storage batteries for equalising the load was the power station at Zurich, Switzerland. Results have there shown that a saving of 2·2 lbs. of coal per H.P.-hour is effected, representing $2,500 per year. Allowing for interest and repairs of accumulators, which, with accompanying apparatus, cost about $7,400, the cost is saved in about four years by the saving in coal. Since, however, the adoption of the battery system replaced more expensive machinery, and therefore actually reduced the first cost, the saving is a direct one, and in a comparison should be credited with the interest charges on the reduction in first cost and the maintenance of the machinery displaced."

In referring to the Gaudini accumulator, it is mentioned that the plates are formed of a mixture of lead and coke and retort-carbon, by the use of which the manufacturers claim to obtain greatly-increased porosity, besides accelerating the formation. It would have been well here to state that it has been for some time well known that such a use of carbon is merely detrimental, this body becoming oxidised when in contact with lead peroxide, and causing, moreover, the oxidation of spongy lead by forming a local couple when in contact with it and the electrolyte.

At page 121 it is stated that "many investigators, including Messrs. Gladstone and Tribe, were of opinion that the local action between the active material and the support plate in the positive electrode led to the disintregation of the latter. If this theory were correct, it would be advantageous to leave the film of sulphate which covers the grid intact." In this sentence, taken in conjunction with the subsequent statement that "the film of peroxide which is formed on charging from the lead sulphate is the real protective coating," there is a curious complication of errors in facts and in logic. The ultimate destruction of the support by local action, which is brought into question, is not merely a theory, but an experimental fact consequent upon a fundamental law. That a film of conducting peroxide, if more or less impervious to the electrolyte, constitutes a protective coating, is a verification of the theory and of the fact. But it does not follow from these that it would be advantageous to leave intact a film of sulphate between the support and the active material. Such a film would be practically a non-conductor; and even if it were a good *electrolytic* conductor, it would render the active material altogether ineffective, as experiment has shown. It does not matter whether the layer of sulphate be a mere film or an inch thick, any peroxide on the top of it would be useless.

We notice that this conclusion is adopted in another portion of the work (page 227), where it is stated that, with the pasted type of plate, "there is great danger of a coating of sulphate being formed between the active material and the grid, especially if the plates are allowed to stand in the acid before charging, or if the charging current be stopped before the active material be thoroughly formed. If this coating of sulphate be once formed, it is almost impossible to get the plate in first-class condition, as the sulphates insulate the active material from the grid, and thus cause the action to take place on the grid itself instead of in the active material. This applies to the positive plate rather than to the negative, since it is easier to reduce the sulphate to spongy lead than it is to oxidise it."

Some interesting statistical information is given at page 141, one item being that, in March, 1897, 77 per cent. of the 265 central stations in Germany employed continuous currents, and all but 20 per cent. of those so doing employed accumulators, whose total output was 31 per cent. of the total power of the direct generators.

In the chapter on Storage Battery Installations, a scheme is mentioned as having been brought forward in France, which consists in supplying all the smaller towns along or near a river front with storage battery plants, these being charged successively by means of a floating central station. Thus many towns, too small to have a complete installation of their own, may be economically supplied with electric power.

The application of storage batteries to traction receives extended notice, throughout which the impression is conveyed that no accumulator specially adapted for this application has yet been devised, or, at least, made public and tested on a sufficient scale. The Theryc-Oblasser accumulator, which is really a form of the Tommasi cell, has been considered to be the exception; it was tested with favourable *primâ facie* results by the French Government, but it is doubtful whether its durability has been established.

The remarks on the treatment and the testing of accumulators, under the heading of Conclusions, deserve careful consideration. In regard to the method of charging, a useful suggestion is quoted from M. Simon, who advises charging under constant power, that is, with a diminishing current and an increasing voltage, the rates being such that their product is a constant. He argues that charging at a constant current takes too long, and that the current is too weak at the commencement and too strong at the end. With a constant P.D., on the other hand, the current may be too strong at first, and so small at the end as to prolong unduly the time of charging. The strength of acid recommended is that of specific gravity 1·270 for thick plates, and that of 1·240 for plates of $\frac{1}{4}$ inch in thickness. The former density, at least, would usually be considered too high.

When sulphate of soda, popularly known as Glauber's salts, is to be obtained everywhere at almost nominal cost, it is difficult to understand why the following recipe for "Urquhart's remedy" (? Barber Starkey's remedy) for sulphated plates should be reproduced, viz.:—"To a quart of strong solution of common washing soda, add slowly, during agitation, 12 ounces of concentrated sulphuric acid. This should be added to the electrolyte in the proportion of 1 : 25." The operation of adding the strong acid to the furiously effervescing sodic carbonate cannot be a very pleasant one; whereas the addition to the electrolyte of a few crystals of Glauber's salts effects the same result in the simplest and easiest manner.

We notice some mistakes which should not appear in a second edition of Mr. Treadwell's work. At page 7 "R. Jamins" is printed for R. Tamine. In the notice of Montaud's elements (page 35) it is stated that "this investigator coated a lead sheet with electrolytic lead from a solution of lead in *potassium and water*." At page 94 magnesium sulphate in a plate is stated to be "eaten away," whereas it is simply dissolved; at page 235 "basic" sulphide is printed in lieu of baric sulphide; at page 218 the word "not" should be deleted from the statement that "the mean ratio of power to gross weight should attain, and should not exceed, 1·2 watts per lb."

NOTES UPON ELECTROLYTIC NICKEL.

By JOHN B. C. KERSHAW, F.I.C.

The electrolytic deposition of nickel is apparently destined to occupy as important a place in the metallurgy of nickel as that of copper in the copper refining industry, and two articles giving the results of laboratory investigations into the conditions necessary for obtaining metallic deposits of nickel by electrolysis which have recently appeared in the *Zeits. für Elektrochemie*, are, therefore, worthy of the attention of readers of the Electrical Review.

The first* is an account of the experimental work upon this subject carried out by Dr. Foerster, of Dresden.

The aim of this investigator was to discover the conditions requisite for obtaining *thick* plates of electrolytic nickel when using anodes of crude nickel containing comparatively small percentages of impurities.

Dr. Foerster found that the difficulty arising from foliation or scaling, which always occurs when a certain thickness of deposit is exceeded under normal conditions of deposition, could be overcome by working with hot solutions of the sulphate, temperatures between 50° and 90° C. being recommended by the author. The deposits were not equally good when the chloride was substituted for the sulphate of nickel, since with this electrolyte it was necessary to add free acid in

* *Zeits. für Elektrochemie*, 4, 160.

order to prevent the formation of basic nickel chloride at the cathode.

The second article * is by Dr. Neumann, of Aachen, and describes the results obtained in experiments conducted with copper-nickel anodes, in solutions of the sulphates of these metals. When using an acid electrolyte of this composition at a temperature of from 20° to 30° C. and an E.M.F. of ·50 volt, copper alone was deposited. If after deposition of the copper in this manner the solution be made alkaline, and the electrolysis be then renewed, the nickel will be deposited; but filtration is first necessary to remove the iron present as an impurity in the anodes, and precipitated from the electrolyte by the excess of alkali.

The Canadian Copper Company are known to be producing nickel by electrolytic methods from the Bessemerised product of the Canadian copper-nickel ores. The matte obtained in this way contains 43 per cent. copper, 40 per cent. nickel, ·30 per cent. iron, and 13·7 per cent. sulphur.

The details of the method used by this company are not known, but it is believed that a solution of nickel and copper sulphate is employed as electrolyte, and that after electrolytic deposition of portion of the copper, the remainder is precipitated by chemical means.

There are three firms who, at present, produce electrolytic nickel upon an industrial scale of operations. These are the Canadian Copper Company, of Cleveland, U.S.A., who work in conjunction with the Balbach Copper Refining Company, of Newark; Messrs. Gustav Menne & Co., of Siegen, Germany; and H. Nikolajev, of the Nijni-Novgorod Electro-Metallurgical Works. According to *L'Industrie Electro-chimique*, a new works for the production of electrolytic nickel is in course of erection at Papenburg, but no details of the process to be used are given.

In a review of the world's nickel industry in the year 1897,† Titus Ulke estimates that the present output of nickel is between 4,000 and 4,500 per annum. The demand for the metal is, however, stationary, and the capacity of the works producing it is stated to be much in excess of the requirements. The average price of refined nickel in the U.S.A. in 1897 was 34·62 cents per lb.

A new process for the production of nickel direct from the ores is attracting some attention in the U.S.A., and if the further experimental trials confirm the results of those already made, the process may become a rival of the processes now in use.

The process is an electro-metallurgical one, and is designed for the treatment of the iron-nickel ores found around Sainte Sault Marie, in the province of Ontario. The details of the method of extraction are somewhat scanty, but from an article recently published in a New York paper‡ the ore appears to be charged into a new form of revolving electric furnace, designed by F. H. Clergue, of Sainte Sault Marie, and to be smelted by aid of the electric arc. A ferro-nickel alloy is obtained by the *one* operation, and samples of this product, submitted to the famous Krupp firm, of Essen, Germany, have led to a large order for this electro-metallurgical ferro-nickel. A 20,000-H.P. plant is said to be contemplated at Sainte Sault Marie for the production of ferro-nickel and nickel steel from Canadian ores; but doubtless the final "0" in this estimate is the result of the natural and excusable inflation produced by recent American naval exploits, and the estimate of 20,000 H.P. must not be taken too seriously.

TRAIN RESISTANCE.

A discussion on train resistance has sprung up in the *Engineer*. Our contemporary is responsible for the statement that high speed diagrams are thinner than low speed diagrams, and, therefore, the resistance at the higher speed must be less than that at the lower speed. The inference appears to be correct. It does not, of course, follow that a thinner indicator diagram implies less horse-power, less steam consumption, for the diagram area does not, perhaps, diminish so fast as the piston speed increases. The work done in a unit of time is greater, even if it is done against a less resistance: for the distance worked against, the resistance is increased. But there is something not very clear in our contemporary's suggestion. If a high speed diagram becomes thinner and thinner as speed increases, it would appear that any further reduction of the diagram area would result in a further increase of speed, and at once we are face to face with the *reductio ad absurdum* of no diagram area at all, and an unlimited velocity.

We are prepared to grant that train resistance does not increase to the extent usually supposed, and we are not prepared to deny that high speed indicator diagrams are thinner than low speed diagrams, but we do not believe that mean effective cylinder pressures are less at high speeds than at low speeds, and would suggest to controversialists before they lose any temper to consider whether much close argument can be built upon the diagram of a high speed link motion valve gear. The subject is difficult to handle, because there is so much difficulty in the taking of diagrams from a locomotive and knowing the exact conditions as to speed and acceleration at the time. If resistance does not increase with speed it would be possible to run high speed trains with very small locomotives by simply arranging to give them an initial high velocity by means of, say, a rope. Once attained, the velocity would be easily maintained. We think it may be taken as a fact in accordance with the doctrine of the conservation of energy that tractive force does increase with speed. That it increases slowly is due to the decreased head resistance of the following vehicles of a train and to the reduction of that particular form of track resistance which is due to the bending of an imperfectly elastic track. Suddenly applied loads may cause a girder to deflect more than a slowly applied load, but it must be remembered that as soon as the velocity of a rolling load exceeds that which would place it at mid span in the time occupied by a body falling by gravity through the space of maximum deflection, the deflection begins to reduce. At high speeds an ordinary rail chair spacing is much below the space proper to maximum deflection, and a reduction of rolling resistance follows. A correspondent at Simla asks for the production of diagrams taken *ceteris paribus* at two speeds showing smaller diagrams at the higher speeds. Granting the possibility of their production, we should, with him, doubt their accurately representing the facts as to the pressure in the cylinder.

* *Zeits. für Elektrochemie*, 4, 316.
† "The Mineral Industry Annual," 1897.
‡ The *Electrical World*, July 2nd, 1898, p. 7.

LONDON COUNTY COUNCIL.

The Council on Tuesday resolved to lend £22,500 to the Islington Vestry and £8,200 to the Shoreditch Vestry for works in connection with their respective electric light undertakings.

An Electric Tramway Manager.

It was decided to style the head of the new tramways department to be formed consequent upon the Council acquiring the system of the London Tramways Company as the "chief officer of tramways," to attach a salary of £1,500 a year to the position, and to issue an advertisement inviting applications for the appointment.

During the discussion which took place prior to the adoption of resolutions to the above effect, Mr. Purchese expressed the opinion that the gentleman appointed ought to be an electrician, but that that was not mentioned in the report of the General Purposes Committee who submitted the recommendations. In reference to this matter Mr. J. W. Benn, chairman of the Highways Committee, stated that it was intended to obtain one of the best tramway administrators possible, with a full knowledge of traction, and especially of the latest forms of electric traction.

The London Telephone Service.

On the motion for the reception of the report of the Highways Committee, Col. Ford asked the chairman of the Committee whether any reply had been received from the Postmaster-General in reference to the letter addressed by the Council asking the views of his Grace on the subject of introducing a competitive telephone service in the metropolis.

Alderman Hubbard, in the temporary absence of the chairman of the Committee, stated that he was unable to give an answer to the question.

The Conduit System in South London.

The Highways Committee reported having received a letter from the South-Eastern Metropolitan Tramways Company asking whether the Council would consent to application being made to Parliament next session for authority to construct certain extensions (several miles in length, and in one direction outside the county) of the company's tramways, and for the use of an underground conduit system of electric traction upon the existing tramways and the proposed extensions. The letter stated that the company were satisfied that the system proposed to be adopted is good and workable, and that they were prepared, if the consent of the Council was given on fair conditions, to incur the large expenditure for carrying out the system. In reply to an inquiry as to the conditions upon which the company would do the work, the Committee were informed that the company, having in mind that an expenditure of at least £200,000 would be incurred, proposed that the Council should give consent on condition that its compulsory purchasing power should not be exercised until 30 years from the passing of the Act authorising the extensions and the use of electric power.

In this connection the Highways Committee mentioned that the company's existing lines within the county are about 2½ miles in length, and that, having been authorised in 1888, they would become purchasable by the Council in 1909. As the Council would in a short time be the owner of the greater part of the tramways south of the Thames, and as other lines would in a few years come within the

purchase clause, the Committee considered that the company's proposals should not be entertained, especially as the adoption of them would defer for such an extended period the acquisition by the Council of the whole of the London tramway systems. The Highways Committee accordingly recommended that the company should be informed that the Council were not prepared to consent to the application on the terms above mentioned, and the Council agreed to this without discussion.

Connecting up London Districts.

The County of London and Brush Provincial Electric Lighting Company gave notice of intention to lay mains of low, high, and extra high tensions in Lancaster Road, and low tension mains along and across Thurlow Park Road; along and across Thurlow Hill, and along and across Lovelace Road and Birkbeck Road respectively. These proposed works are for roads situated in the parish of Streatham, detached, and part of them were included in that portion of the company's notice which was previously disapproved by the Council. The reason for such disapproval was that the works appeared to be intended to form a connecting link between the company's works in Wandsworth and certain proposed works in Camberwell, thereby enabling the company to obtain a supply of electricity for the purposes of its Camberwell order from the generating station in Wandsworth, an arrangement which, in the opinion of the Highways Committee, seemed undesirable, and likely to cause inconvenience at the time for purchase by the local authority under the Camberwell order.

The Highways Committee stated that since the disapproval of these works, the Council had, on several occasions, refused to sanction works intended to accomplish the same purpose. The company appealed to the Board against these subsequent decisions of the Council; the works referred to in the present notice not, however, being included in this appeal. Major Cardew held an inquiry on behalf of the Board of Trade on October 3rd, but the Board had not yet given its award. Pending the decision of the Board of Trade, the Highways Committee expressed the opinion that the Council should withhold consent, and made a recommendation to that effect. The recommendation was adopted.

Works in Blackheath.

The operations of the Blackheath and Greenwich District Electric Light Company were again considered consequent upon the receipt of fresh notices from the company of intention to lay mains in Blackheath Road and Lewisham Road, from Deptford Bridge to the boundary of the Greenwich district; and from that boundary along Lewisham Road and Hill, Aberdeen Terrace, Haddo Villas, and Eliot Hill, Vale, and Place. The company had also submitted six other plans, giving full details of the proposed works. The works referred to in these notices are a repetition of those which were formally disapproved by the Council on September 22nd. It appeared at that time that the company intended to obtain from the London Electric Supply Corporation's main at Deptford Bridge the supply of electrical energy for the areas referred to.

Since then, according to a report submitted by the Highways Committee, the company had written stating that they were making arrangements for the erection of a generating station within the area of the provisional order, and that they were anxious to have everything ready to commence the supply on the completion of the station. In consequence of this communication the Committee informed the company that the matter would be again considered on fresh notices being served upon the Council. This having now been done, the Highways Committee, under the above circumstances, recommended, and the Council decided, with the exception of the proposed laying of mains along Deptford Bridge, to approve all the other works specified in the notice.

The Lucky Lambeth Company.

It was announced that notice had been received from Messrs. Kincaid, Waller & Manville, on behalf of the South London Electric Supply Corporation, under the Lambeth order, 1892, of intention to lay mains in Denmark Hill. The order was originally granted to the Vestry, and subsequently transferred by agreement to the company; and contains no provision enabling the Council, as in the case of orders granted to companies direct, to approve or disapprove of works.

CORRESPONDENCE.

The Dumoulin Copper Depositing Process.

At last we have some particulars of the Dumoulin copper depositing process given by Mr. Kershaw in your columns last week, and I find that they have entirely thrown over the idea upon which they started, namely, of having a fatty rubber, and they now find it necessary to use "strips of sheep skin from which the fat has been extracted by chemical treatment."

They ought to know that this process of burnishing with a soft rubber was patented years ago, and the patent is still in force.

M. Dumoulin was probably aware that he could not dispose of a patent for burnishing with leather, and in his first English patent of 1895 he claimed burnishing with a "body impregnated with fatty matters."

In the German patent of 1896 he stated that the "substance for insulating (by this he means the fatty or other organic matters) may also be put into a solution into the bath."

In the patent of 1897 he stated what is perfect truth, namely, that "when the organic matters come into solution they adhere to the cathode" "and thus generate gases" upon annealing, "which makes the metal short and brittle."

In this latter patent he claimed the use of rubbers from which the fat has been extracted, this, as above-mentioned, being quite old.

The Electrical Copper Company working the Dumoulin process paid £400,000 for the patents. It has taken them between two and three years to find that these patents cover a process which introduces fat or organic matter into the deposited metal. It was well known by those acquainted with the electrical deposition of copper articles, that this produced defective results, or to use the words of Dumoulin's later patent, "makes the metal short and brittle." The Electrical Copper Company do not yet appear to have found out that what they are now working has been previously patented.

F.

The admirable description of the Dumoulin copper depositing process by Mr. Kershaw, which appears in your issue of the 14th inst., will, I am sure, be appreciatively perused by all your readers who take an interest in the growing electro-metallurgical industries.

I am interested to see by its account by, I presume, an independent authority, that it is now found necessary to exclude all fat and grease from the sheep-skin rubbers, for this is precisely what the Messrs. Elmore have always alleged as a fundamental necessity of the process.

Of course, one cannot but wonder now wherein there can exist any difference from the Elmore system. I have always heard that the "Elmore" was the master patent for the principle of depositing upon a revolving mandrel and obtaining a dense, smooth deposit by the friction or pressure of a burnisher of any kind acting upon the surface of a revolving mass during its formation. If there is any other principle involved in the Dumoulin system, perhaps Mr. Kershaw could make clear what it is.

B.

I have carefully read Mr. Kershaw's article on the Dumoulin process published in your issue of the 14th inst., Mr. Kershaw opens his article by saying that he visited the works of the Electrical Copper Company, and it is to be presumed that he carefully examined the process whilst in operation, yet I see later on he says in the article that the Dumoulin process, as carried on at Widnes, is *said to prevent* (the italics are my own) "any roughness in the deposit." It would appear from this that Mr. Kershaw does not like to make a statement that such is the case on his own authority.

C. Mellish.

Your article on the Dumoulin process now worked in England by the Electrical Copper Company, Limited, in your issue of the 14th, shows that the same mistake is being repeated that was made at the commencement of the working of the Elmore process, with the addition that whereas undoubtedly Elmore had made a valuable discovery, the patents for which appear to have stood, in the Dumoulin case they have asked £400,000 for patents which seem to be of considerably less value, and, as far as one can judge from their balance sheet, they must have by this time used all their working capital.

The history of the Elmore process is very instructive. The English companies seem to have made no headway, there being a large paper capital and very small working capital. In France the case was identically the same, until they got a large amount of working capital into the business, several hundred thousand pounds being found in actual sovereigns, with the result that to-day they undoubtedly hold the premier position in the metallurgical world in France, and have established beyond doubt the great value

of the Elmore process. Last year their profit was £53,000; this year the profit will be much larger, as they only had the advantage of their extra capital for a part of the previous year.

A Shareholder in the Elmore Companies.

The Position of Draughtsmen.

Your correspondent in last Friday's issue has thought fit, under the above heading, to criticise the system of premium pupils. It seems a pity that one so gifted should not have gone on and given us some suggestions as how to enter the profession.

Now, if as your correspondent says, a draughtsman can be ousted from his position by a pupil with only a smattering of the business, surely we may conclude that this draughtsman is not of much value to the firm he is serving.

I have been a pupil for three years with a firm of electrical engineers, but I regret to say no kind and influential friend has as yet come forward to get this "dear boy" one of those "comfortable jobs, at a fair remuneration, where the best part of what he has to do is shown him."

Nor do I know of any other premium pupils, and I have seen a good many, who have been treated in this kind way.

I will also say that I have not as yet met one of those draughtsmen who was able to provide me with much information, except that directly connected with the drawing office. I should like to suggest to your correspondent that there are other posts in the profession where "good experience as a draughtsman" is of almost no value whatsoever, and consequently, if a draughtsman applies for these he must expect to be rejected.

I am not going to discuss further the position of a draughtsman, but I must add that to be an efficient draughtsman previous experience in the shops is absolutely necessary. If a man "remains for years" in the drawing office, making this his speciality, he cannot expect to compete with success for many other posts.

But to return to my point, I say there is no better method of studying the profession than that of regularly going through the shops as a premium pupil.

If your correspondent knows as little of his business as he does of premium pupils, then I should certainly suggest to him that he become a "cab driver under police supervision."

Truth.

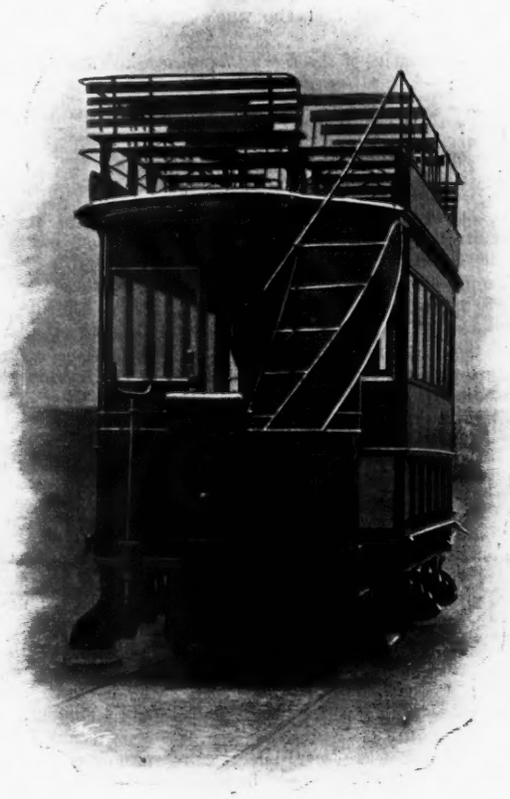
"ELECTRIC TRACTION WITHOUT OVERHEAD WIRES."

On Saturday last we witnessed some experiments with the Thompson-Walker system of surface contact electric traction on a length of some 190 yards of track, with 36 studs, laid in a yard at the engineering works of Messrs. Baker & Son, Willesden.

In our issue of last Friday we alluded to this subject at some length under the heading of "The Supersession of the Trolley," basing our remarks—every word of which we are prepared to uphold — upon a letter entitled "Electric Tramways without Overhead Wires," sent by the professor to the *Westminster Gazette* and an inspired article which appeared in the *Pall Mall Gazette*. So that it cannot be said we mistake Prof. Thompson's points, and then misstate them, we give to this article the title which appears on the descriptive pamphlet, "Electric Traction Without Overhead Wires," and amongst other things we will endeavour to ascertain to what extent the professor's points of "safety, simplicity, and economy," can be maintained.

"The main difficulty," quoting from the pamphlet, "standing in the way of the general adoption of electric traction on our English tramways has arisen in connection with the mechanism for conveying the power from the fixed conductors to the moving car." While we have nothing to urge against the acceptance of this statement, we would like to say that so far as surface contact systems are concerned, the long and short of the whole thing is simply that the difficulties of working complicated electrical apparatus under the street surface are very great, and so far no practical result has been gained of any importance, and in the present state of the art we think it extremely unlikely that anyone gives consideration to the use of surface contact or closed conduit systems when either the open conduit or the trolley wire are at all possible.

We will now without further ado proceed to give our impressions of the Thompson-Walker system from both mechanical and electrical points of view, with the proviso that we do not consider the running of a single car on a few yards of track, even when no hitch or breakdown takes place, affords any proof that the system would in practice prove cheap, simple, and reliable. Reckenzaun's, Elieson's, Jarman's, Lineff's, and other systems gave excellent results on an experimental track with a single car, and all these inventors estimated that horse traction hadn't the ghost of a chance of competing with them on the score of efficiency and economy, but where are those systems now?



Thompson-Walker Car.

And it is just this which shows how little dependence after all can be placed upon intermittent and desultory garden experiments in fine weather, although that mighty organ which has totally routed the French invasion of this country, in the person of M. de Rougemont, placidly remarks: "This Thompson-Walker system has borne the test of a trying experiment with perfect success."

We were shown mercury contact switches which had been in use, it is said, for the past three months, and we must frankly admit that the contacts looked clean and bright, acting as they do in oil.

But the number of times these switches have made and broken contact on that experimental track with a single car during this period would certainly be less than would occur in a single day on a line, say, such as that of the London Southern Tramways Company, between Vauxhall, Camberwell, and Norwood. Let us take that portion between Stockwell and Loughborough Junction—approximately a mile. The cars going to and fro represent 46 cars on a single track with turn-outs, and a 4-minutes' service. Assuming that there are 360 studs along the length of line, each one will be operated 30 times in an hour, or 480 times in the

running day of 16 hours, a grand total of 172,800 makes and breaks in one mile of line per diem.

A fairly complete description of the system appeared in the British Association paper which was concluded in our issue of October 14th, the most important difference that we noted on Saturday being in the switch. This arises from the fact that experiments have resulted in various modifications being introduced from time to time. The switching device that seemed to be mainly employed on the track at Willesden consisted of a shunt coil taking about ½ an ampere at 500 volts and operating a two-pronged switch, the function of which was to complete the main circuit by dipping into two mercury cups, its action appearing not unlike that of the Woodhouse and Rawson cut-out, which, though in common use some years ago, is never heard of now. Contiguous to the mercury cups were two carbon projections, upon which rested, when the main switch was closed, two carbon points. These form a shunt to the mercury circuit, and as the connection between them is not supposed to be broken till the prongs had left the mercury cups, they should take up the sparking that ensues upon the breaking of the current. It may be pointed out that the whole of the device is under common paraffin oil.

A representative of the *Daily Chronicle* asked the following question :—

Suppose the roadway is dirty, and your studs covered with mud or water?

The reply is thus reported —

It makes no difference. We left some of our studs in hollows, and they are frequently covered with water or mud, but the contact is made just the same. We have put bricks, bits of wood or tin over them, but they were swept aside by the skate without any interruption of the car.

Yet by placing a newspaper on the stud that the car was slowly approaching we saw the main current broken time after time! This is easily understood, because the continuity of the main current is dependent on the skate making contact with the stud it is approaching, before leaving that immediately preceding it, the one, indeed, it is at the moment gliding over. If by any means, such as covering the top of the stud with, for instance, a sheet of paper, the necessary contact is not made, there at once occurs the rupture of the main circuit and the necessity of using the 500-volt accumulator on board each car to re-establish continuity of the main conductor. This battery consists of 250 small cells giving an output of ½ an ampere for five hours, and costing £11. It is worked from the controller.

From a mechanical point of view, too, the picking up of the current does not commend itself.

The skate, a flimsy looking device, is not more than half an inch from the surface of the road bed, and, like the stud, is rigid. A slight sinking of the rails would cause the skate and stud to bind; on the other hand, should a depression of the middle of the track take place, the skate would fail to make contact. As these defects are common to tramway construction, springiness will be found necessary somewhere.

As regards the "mercury contacts" themselves we must express our opinion, an opinion which we are confident will be endorsed by practical electricians and engineers, that the use of such will be fatal to the system. The employment of mercury contacts is not a thing of yesterday, they have been tried again and again; they have often appeared likely to give promising results, but their eventual fate has invariably been the same, namely, complete failure. Mercury contacts, where makes and breaks only occasionally take place, are useful and reliable, but only provided they are continually looked after. At every break, oxidation or volatilisation takes place, and minimise this as much as you will, it eventually causes failure. Let anyone look up the numerous cases in which mercury contacts have been used, whether for electric light switches, railway automatic signals, electric clocks, &c., and what has been the result—universal abandonment. Prof. Thompson, with reference to his system may say: But my system of contacts actually does work, I have had it in use for months on my experimental line. An instructive answer to this is the case of the almost forgotten atmospheric railway of Clegg and Samuda. In this railway, which was experimentally found to be successful, and as a consequence laid down on a large scale on the Croydon and also on the South Devon Railway and worked for months, there was a weak point, namely, the valve which enabled mechanical communication to be established between the tube piston and the outside of the tube so as to connect this piston to the carriage; every conceivable device which ingenuity could bring out was tried in order to make this valve reliable, but it *would* fail and the failures were the death blow to the system. The mercury contacts will, we firmly believe, stand exactly in the same position, and their failure will ring the death knell of the Thompson-Walker tramway if ever the latter is worked on a practical scale. Given an unlimited amount of maintenance the mercury contacts could possibly be kept in order, but unlimited maintenance, in the shape of a large staff of inspectors, is not a paying arrangement.

And now for the question of economy in construction.

As regards the estimates given in the pamphlet they are, in our opinion, decidedly misleading, as far as the overhead system is concerned. We could safely guarantee to put up the finest overhead system, including poles, brackets, junction boxes, trolley wires, insulators, and everything ready complete for running in the best possible style for £1,000 per mile of street; whether single or double track does not alter the cost, as two wires are always used.

As regards the permanent way, for a standard gauge of 4 feet 8½ inches, £3,500 is a very low estimate, and from a personal experience of several instances we believe that this work cannot be thoroughly done under £4,500 per mile.

As regards the feeders, the estimate of £4,000 given seems very excessive, and we are certain that the best possible system can be installed and that more than £2,000 need not be expended. In this connection it must be borne in mind that the trolley wires act as feeders, which is not the case in the surface contact system. The total cost of a first-class overhead line per mile of street, including track, bonding, and trolley wire, complete and ready for running with feeders, ought not to exceed £7,500.

As regards the open conduit, the cost of this class of work we believe is also under-estimated, certainly for English conditions, and in streets so filled up with wires and pipes of every description. The cost of a first-class conduit, we think, could not be done at less than £5,000 per mile of single track, and probably £8,000 to £9,000 per mile of double track. The permanent way in paving would be the same as in the overhead system, and would cost £4,500 per mile of single track, or about £9,000 per mile of double track. The feeders which would be required would not exceed those requisite for the overhead system, and would amount to about £2,000 per mile of street; whether single or double track is not very material. It must be remembered that in this case also the conductors in the conduit act as feeders and go to increase their sectional area.

As regards the surface contact system, we think that the figures are probably rather too low than too high. The minimum number of contact boxes, with long distances between them would scarcely be satisfactory, and a greater number would be required. The cost of these fixed is, in our mind, also under-estimated, as it must be remembered that several connections would have to be made to the feeders, and that they would have to be very well bedded and fixed in such a way as not to sink. We think that before they were done with, actual practice would demonstrate that they could not be put down at much less than £10 a piece, which would bring the cost of 360 contact boxes, completely fixed, to £3,600 per mile of single track. The permanent way would cost £4,500 per mile of single track. The feeders and adjuncts have been worked out by Prof. Thompson at £4,200, and as he ought to know what is required, we will not criticise these.

Taking an estimate for one mile of single track in accordance with the figures given above, they would work out as follows :—

1. Overhead system £7,500
   This includes double wire, but single track, and also necessary feeders, junction boxes, bonding, &c.
2. Open conduit £11,500
   (We believe this to be very much under-estimated.)
3. Surface contact system, taking 270 boxes per mile of single track, would cost £11,400

These figures we believe would be fairly approximate, but we do not think that a satisfactory contact system has yet

been devised or erected anywhere. It is not fair to cite the one in Monaco, which is operating under exceptionally favourable climatic conditions which do not obtain here, and which has not yet been at work long enough.

Our readers will no doubt remember a couple of years ago the great noise that was made by the Claret system, and the blast of trumpets with which a mile and a half or two miles were installed in Paris. For about a year the line worked fairly satisfactorily, after which time faults manifested themselves, causing several serious accidents both to people and animals. Proof that this system is not a satisfactory one is shown by the fact that the tramway companies, to whom the municipality of Paris will not allow the use of the overhead trolley in certain streets, are laying down the open conduit, or are using accumulators. It is perfectly possible that some surface contact systems may be practicable and satisfactory, but from the experience we have had, we cannot admit this to be the case until a trial under the most difficult circumstances has been made by a disinterested company for a period of at least three years.

We do not wish to assert that the Thompson-Walker system is any worse than those which have been previously proposed and abandoned, but we fail to see its immense superiority, notwithstanding the ingenuity and skill which has been brought to bear upon it. "London," said the professor in his letter to the *Westminster Gazette*, and here there is no misconception, "has done well to wait for something better than the overhead trolley wire." Judging, however, from the schemes so far proposed, it appears that London will go on waiting.

Röntgen Rays in Medical Work. — A complete Röntgen ray equipment has been presented to the North-Eastern Hospital for Children, Hackney Road, Shoreditch, by the Duke of Newcastle. The apparatus throws an 18-inch spark, and is one of the largest and most efficient in existence.

NEW DYNAMOS.

During the past two years Messrs. P. R. Jackson & Co., Limited, of the Salford Rolling Mills, Manchester, have been carrying out an important series of experiments with dynamos having slot-wound armatures and copper brushes. The object of these experiments was to secure sparkless commutation, with an absolutely fixed brush position for all loads, and even when the dynamos were considerably overloaded. The result has amply justified the heavy cost of the undertaking, inasmuch as a large number of dynamos embodying the foregoing features and ranging in size from 40 to 400 H.P. have been constructed. The machines are built on the Sayers system of winding, but with the special improvements of Messrs. Jackson, which have been patented in this country and abroad, including Germany and America.

Fig. 1 is an illustration of a 150-kilowatt Jackson-Belliss steam set. The dynamo is a four-poler. The outer ring or yoke of the magnets is of Messrs. Jackson's own special steel, as are also the magnets and pole-pieces. The ring is partially enclosed at the sides with gun-metal gratings, which not only afford protection to the field magnet coils and the armature, but facilitate the work of connecting the magnet coils, and afford considerable support to the pole-pieces. The whole of the pole-pieces are cast and machined together in a special patented method of Messrs. Jackson's. This method secures solid metal at the pole tips and obviates the necessity of annealing the steel. The shunt winding is quite separate from the series winding, and all joints are made with thimbles and bolts. The core is built on a spinder, and the shafts are removable. The commutator is built on an entirely new principle, which we hope to describe in detail later on. The bearings are of the separator type, and are self-oiling, without loose rings or other such devices. The brush gear is also of patented form, the holders being designed to give a light elastic tread to the brushes. The brush holders are adjustable lengthways on the brush spindle, and there is also screw feed and hold-off adjustment. The springs, which are all of stout flat steel, are enclosed in the body of the holder, and can be adjusted to give any desired brush pressure. The brush leads are attached underneath the commutator to two circular collectors. These enable the leads to swing clear of everything to two terminals on the bottom side of the gun-metal grating. The two main terminals are on the opposite grating, from which point they may be very conveniently connected to the underground or overhead cables.

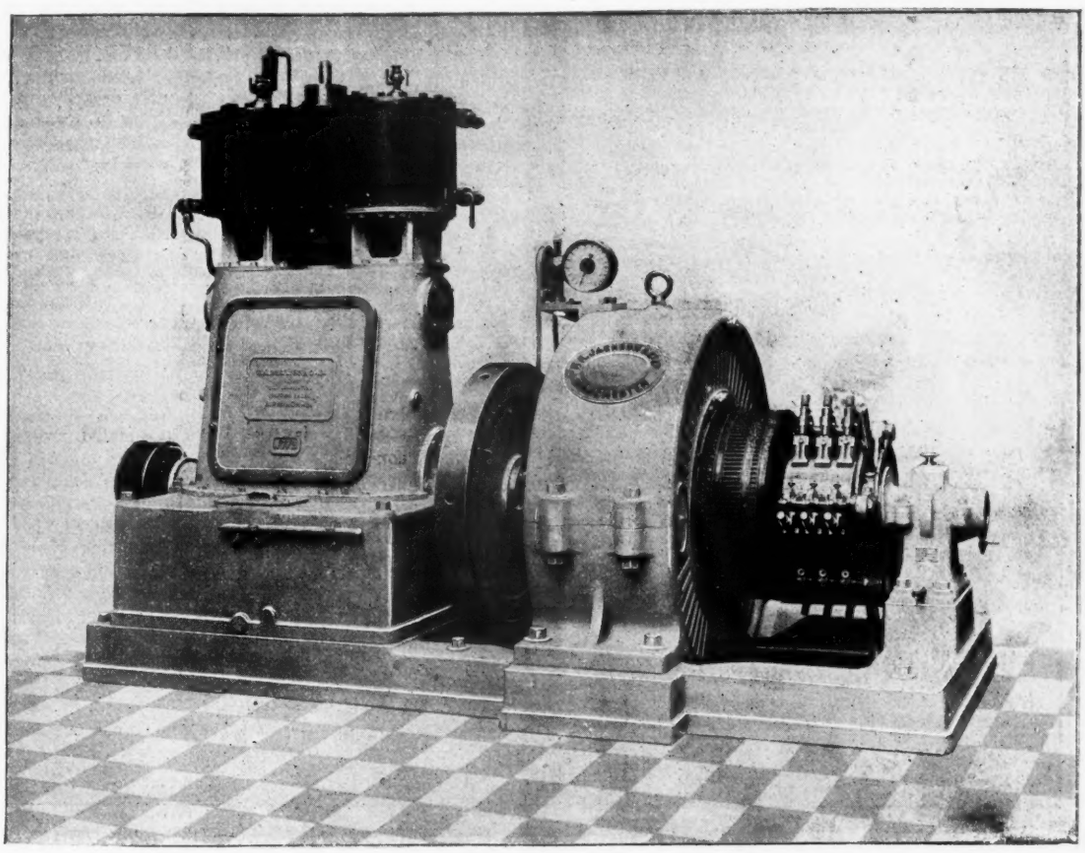


Fig. 1.

Fig. 2 is a similar machine arranged for rope driving instead of being directly connected to an engine.

Another type is a two-pole machine, with a capacity of 200 kilowatts at 450 revolutions per minute. Three of these dynamos are now at work in a large works in Lancashire, where the current frequently varies throughout the full range of the machines. The brushes (copper) are not only absolutely fixed in one position throughout the full variation of the load, but even where it is exceeded by 20 or 30 per cent. Notwithstanding this overload the dynamos run absolutely sparklessly and without trouble of any kind whatever.

Three 500-H.P. direct driven sets are now nearing completion; we hope to give particulars of these in the course of a few weeks' time.

It may be remarked in connection with these new dynamos it is stated that they not only possess these striking electrical advantages, but that they compare very favourably in point of cost of materials and workmanship, with any other type of direct current machine. We understand, however, that Mr. Slater Lewis, engineer and general manager to Messrs. Jackson, who undertook the responsibility of adopting this type of machine as one of Messrs. Jackson's standard dynamos, and of initiating and pushing forward the experiments which led up to such important results, will shortly present a paper upon the subject to the Institution of Civil Engineers. It will be observed that the outward appearance and mechanical features of these new dynamos are peculiarly distinct in every particular from those of other makers. This is due to the fact that Mr. Slater Lewis approached this portion of the problem with a full determination to arrive at the best mechanical method of constructing each part—consistent, of course, with general symmetry, strength, and cost. The ultimate success of the experiments are, however, largely due to Mr. F. J. Howitt, the electrical engineer to the company, whose energies have been so ably directed to achieving the desired result.

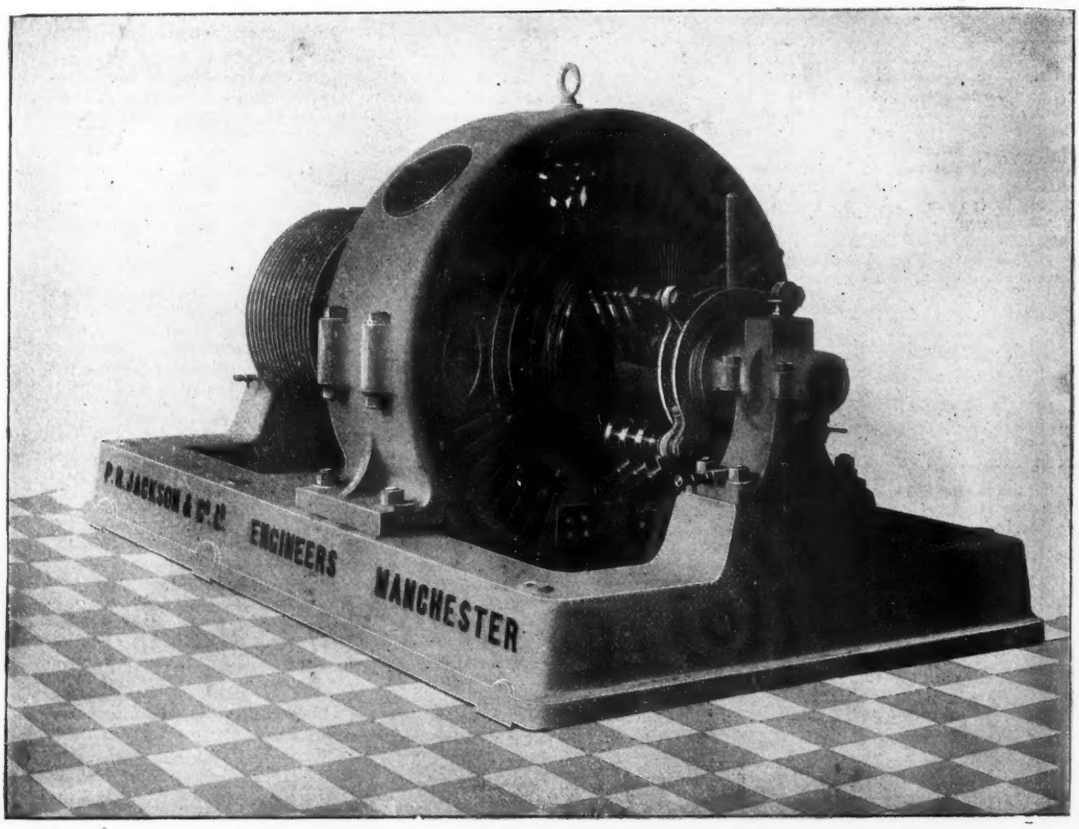


Fig. 2.

BUSINESS NOTICES, &c.

Alleged Fraud.—A young man named A. J. P. Allen, was charged at the Birmingham Police Court last week with obtaining goods from various people under false pretences. He represented to the various firms from whom he secured a number of batteries, magnets, and spirit levels, that he was acting on behalf of certain electrical firms in Birmingham. He has been committed to the sessions on bail.

Alleged Perjury.—At Bow Street on Monday, John Limbrey Higgs, of Delahaye Street, Westminster, appeared to answer a summons charging him with committing perjury during his examination in May last, at Bankruptcy Buildings, in respect to the I.E.S. Accumulator Company. Mr. Horace Avory and Mr. G. A. Scott supported the summons; Mr. Bartley Denniss defended.—Mr. Avory said that the defendant, who appeared during recent years to have been engaged in company promoting, was charged here with having committed wilful and corrupt perjury in his examination in respect to the affairs of the I.E.S. Accumulator Company, in swearing that a mortgage deed, secured to a Mr. John Walton, for £1,200, dated May 9th, 1894, had been paid off and satisfied prior to August, 1895. This mortgage related to a license to work a particular patent in electrical accumulators, known as the Theryc-Oblasser accumulator, which it was intended to have fitted to electrical cabs and other motor vehicles. In December, 1893, the defendant agreed to purchase this license for £2,000, and in the following January promoted a company, known as the Universal Electrical Lighting Company, to obtain the purchase money and work the patent. Only £1,200 was subscribed to this company, however, and the defendant accordingly mortgaged this license to Mr. Walton for a second £1,200. The license was not assigned to the company, but in June, 1895, the defendant entered into an agreement with Mr. Mann, as trustee for a new company, to buy this license for £2,000. This company was duly formed under the name of the I.E.S. Accumulator Company, with the defendant and his father-in-law as two of the directors. The purchase of this patent did not appear on the prospectus, but at a board meeting on July 26th, 1895, at which the defendant was present, the directors agreed to acquire the patent, and to pay the defendant £2,000 for it, and this sum was actually paid to him by several cheques in 1895. In 1897 the company got into difficulties, and in October of that year called an extraordinary general meeting to consider the voluntary winding-up of the company. Some of the shareholders opposed this motion, saying that certain practices had come to their knowledge which required fuller investigation, but the voting power of the directors was sufficient to get the motion carried. However, in March, 1898, an order was obtained for the examination of the defendant and other directors in respect to this company, and then he, having been obliged to admit the mortgage of 1894, in order to justify his subsequent sale of the license, swore that the mortgage was paid off before August, 1895. As a matter of fact the mortgage was never paid off until October, 1897, when the defendant found the money because he was moving to have a receiving order against him rescinded, and to satisfy the registrar that he had paid all his debts he had to produce this mortgage and the receipt, dated October, 1897, so that he had made two conflicting statements, and condemned himself out of his own mouth. At this point the hearing was adjourned for a fortnight, Mr. Denniss saying that he should be prepared to prove that the defendant never had received the £2,000 purchase money for this patent from the company.

Electrical Wares Exported.

Week Ending Oct. 25th, 1897.	£	s.
Alexandria. Teleg. mat.	17	0
Amsterdam	107	0
Antwerp	85	0
Barcelona. Teleg. mat.	10	0
Brisbane. Teleph. mat.	129	0
Brussels. " "	80	0
Calcutta	114	0
Canterbury	28	0
Chinde	13	0
Cologne. Teleg. mat. ...	1,572	0
Colombo...	438	0
Copenhagen	127	0
Durban	670	0
East London	53	0
Fremantle	66	0
Gibraltar	8	0
Halifax. Teleg. cable	20,500	0
Hiogo	25	0
Lisbon	50	0
Madras	30	0
Malaga	160	0
Melbourne	66	0
" Teleg. mat.	1,364	0
Ostend	60	0
Santos	476	0
St. Petersburg { Teleg. / cable	216	0
Shanghai	298	0
Singapore. Teleph. mat.	21	0
Stockholm. Teleg. wire	39	0
Sydney	255	0
" Teleg. cable ...	33	0
Wellington	454	0
" Teleg. mat.	623	0
Yokohama	10	0
Total	£28,197	0

Week Ending Oct. 25th, 1898.	£	s
Adelaide	12	0
Albany	121	0
Amsterdam	10	0
Batoum	50	0
Bombay	105	0
Brisbane. Teleg. wire	53	0
Buenos Ayres	56	0
Calcutta	657	0
Cape Town	176	0
Colombo...	53	0
Copenhagen	400	0
Durban	133	0
Hamburg	654	0
Hong Kong	1,025	0
Limon	12	0
Madeira	122	0
Madras	19	0
Malaga	22	0
Marseilles	19	0
Melbourne. Teleg. mat.	296	0
Odessa " "	70	0
Ostend	30	0
Otago	51	0
Rotterdam	4,478	0
St. Petersburg	175	0
Santos	120	0
Shanghai	200	0
Singapore	25	0
Stockholm	424	0
" Teleg. mat.	360	0
" Teleg. cable	432	0
Trinidad	36	0
Wellington	2,710	0
Yokohama. Teleg. mat.	1,645	0
Total	£14,771	0

Foreign Goods Transhipped.

Rangoon.	Teleph. mat.	164	0

Bankruptcy Proceedings.—A meeting of creditors of C. H. Kitching, plumber and electrical engineer, Hull, was held on 21st inst. at the offices of the Official Receiver. Debtor returned his gross liabilities at £3,296 19s. 4d., expected to rank at £2,284 17s., and his assets at £1,365 13s. 10d., which left a deficiency of £919 3s. 2d. He attributed his failure to want of capital and bad debts. He commenced business, trading under his own name and also as "The City Electric Lighting Works," in March, 1896, without any capital, but he borrowed £200 from a finance company, agreeing to pay £250 by instalments, and he had repaid about £70. Mr. J. H. Fox, of Messrs. Grey & Co., was appointed trustee, with Messrs. A. Armstrong, F. Hall, and W. D. Richardson as a committee of inspection.

The last day for receiving proofs of dividend in the failure of Geo. F. Rogers, electrical engineer, Notting Hill and Gt. Winchester Street, E.C., is November 7th, 1878. Mr. E. B. Lumb, 85, Gracechurch Street, E.C., is trustee.

Dissolution of Partnership.—The partnership hitherto subsisting between Messrs. Leslie Miller and Maurice W. Woods has been dissolved by mutual consent from October 17th, and in future each will carry on business separately and for his own account. Mr. Leslie Miller, as stated below, has taken new premises at 93, Hatton Garden, E.C., and will trade in his own name, and Mr. Maurice W. Woods will continue at 2, Gray's Inn Road as at present, trading under the name of Woods & Co.

Books Received.—"Gas and Petroleum Engines." By A. G. Elliott (translated and adapted from the French of H. de Graffigny). Whittaker & Co., London. 2s. 6d.

"First Stage Inorganic Chemistry (practical)." By F. Beddow. W. B. Clive, University College Press, London. 1s.

"A Pocket Dictionary of Electrical Words, Terms, and Phrases." By E. J. Houston. Swan, Sonnenschein & Co., Limited, London.

"Electricity made Easy." By E. J. Houston and A. E. Kennelly. Swan, Sonnenschein & Co., Limited, London.

"Algebra made Easy." By E. J. Houston and A. E. Kennelly. Swan, Sonnenschein & Co., Limited, London.

"Interpretation of Mathematical Formulæ." By E. J. Houston and A. E. Kennelly. Swan, Sonnenschein & Co., Limited, London.

Business Announcement.—Mr. Leslie Miller has taken a showroom and office at 93, Hatton Garden, E.C., with workshops near at hand, and intends to carry on the business of a manufacturing electrician. The whole of the patents used by the late firm of Miller and Woods, were Mr. Miller's inventions, and he retains the sole right to manufacture under them.

Claim for Personal Injuries.—An action, which stands adjourned, was partly heard at the Leeds County Court on October 21st, wherein Reginald Hewitt Pearson, Gainsborough, sought to recover from Mr. Wilson Hartnell, electrical engineer, of Kirkstall Road, Leeds, the sum of £210 12s. for personal injuries.

Damages.—At Salisbury last week a haulier named Baker secured a verdict for £40 damages for personal injuries against the National Telephone Company. Plaintiff's leg was broken by the negligence of the company's men who were removing a telephone post at the Milford Goods Station, Salisbury, on July 20th, 1898.

At the Leeds County Court on October 21st, Albert Richardson, of Keighley, brought an action to recover £50 damages from the Leeds Corporation for personal injuries caused by the driver of an electric car refusing to stop when the plaintiff's horse was in a restive condition. Judgment was eventually given for £30.

Dividend.—The Helios Electricitäts Gesellschaft, of Ehrenfeld, Cologne, reports a profit of £60,626, for the financial year, 1897-98, and is declaring a dividend of 11 per cent., as compared with 12 per cent. in the preceding 12 months.

Electric Power Transmission in Austria. — An electric power transmission plant is at present being laid down at the locomotive works in Vienna of the Austro-Hungarian State Railway Exploitation Company. The plant, which is being supplied by Messrs. Ganz and Co., of Buda-Pesth, comprises a compound engine, direct coupled to a 300-kilowatt three-phase dynamo and a 60 kw. steam dynamo. At first 30 electromotors, ranging from ½ H.P. to 30 H.P., will be installed, aggregating 400 H.P. The works are also to be lighted by electricity.

Extension of Premises.—Owing to the great increase in the demand for their telephones the General Electric Company have found it necessary to extend their premises very considerably to facilitate business in this direction. They have, therefore, taken the premises at No. 92, Queen Victoria Street, and have opened these as a telephone department, where a large stock of telephones and accessories will be kept. At the Manchester works there has also been built a very large wing to their extensive factory, so that more room may be available for the manufacture of telephonic apparatus.

Lists.—Messrs. A. J. Beaumont & Co., of York, send us a list of their specialities for theatre, stage, cinematograph, and other scientific purposes. The specialities include projectors, and a number of types of automatic and other arc lamps, such as the "Nouvelle," the "Eureka," "Comme-il-faut," "Jubilee," and "Ajax."

From the Glasfabrik "Marienhütte" Carl Wolffhardt, of Wien, we have received an illustrated list, printed in German, of silvered reflectors for electric lighting, also one showing various kinds of insulators.

An illustrated catalogue of electrical instruments has been sent to us by Signor C. Olivetti, Ivrea, Italy. The list gives some neat illustrations and descriptive matter in Italian of several types of galvanometers, resistance boxes, mercury commutator, amperemeters, and voltmeters, &c.

Messrs. Dixon, Clayton & Co., of Penistone, are sending out a number of lists collected together in a binding file with an arrangement for conveniently inserting new lists as they are issued. The articles described in the present sheets are ceiling roses, cut-outs, distributing fuses, distributing boards, and a variety of switches, including the "Clip" type, the "Gem," the spring contact switch, Y-type, and others, also Dixon's water-tight bell, and other electrical apparatus.

Messrs. Connolly Bros., Ltd, of Manchester, have brought out a list of vulcanised rubber cables and mains for electric light and power, concentric electric light cables, unvulcanised light insulation wires and cables, aerial conductors, flexible cables for dynamos and switchboard connections, fuse wires, steel conduits for electric wiring, house wires for bells, telephones, &c. The information is given principally in tabulated form.

Motor Car Breakdown.—Before the Walsall magistrates on Friday, Ernest Robins, manager of the Remington Typewriter Company, was summoned for causing an obstruction in Park Street by allowing a motor car to remain thereon on October 3rd. The evidence showed that, as one witness put it, "something went wrong with the works," and the car ceased to run, with the result that some 150 people gathered round, obstructing the roadway. Defendant told the officer who interposed that he was "waiting for a spark." Mr. W. F. Hall, who appeared for the defendant, stated that there had been a temporary disarrangement of the gear. It was not the fault of defendant that a crowd congregated; it was due, he said, to the "inordinate curiosity of the Walsall people, who assembled on the slightest pretext." Defendant, who was called, stated that the accumulator of his motor car would not work, and he sent to the Walsall Electrical Company for a new one. He maintained that he had as much right to use his motor car as to use a trap. The magistrates took a lenient view of the case. They accepted the explanation that there had been a breakdown, and the case was dismissed.

Motor Cars. — The London Motor Van and Luggage Company intend running a service of motor cars between Paignton and Torquay. The proposal has been sanctioned by the local authorities.

New Zealand Electrical Syndicate, Limited.—Mr. Carson, Q.C., appeared before Mr. Justice Stirling, in the Chancery Division of the High Court of Justice on the 24th inst., just after the re-opening of the Courts at the close of the Long Vacation, and asked that his Lordship should fix a day for the hearing of the petition of this company, which was one to reduce capital. In compliance with the reference already made by the Court, Mr. Waterhouse had made his report on certain points in the evidence, and therefore it was desired to restore the petition. His Lordship said that the matter had better be set down for the next petition day.

Partnership Notice.—Mr. Henry Lyon informs us that he is no longer in the employ of Messrs. D. Stewart & Co., Glasgow, but has commenced business in partnership with Mr. J. B. T. Crosbie, as consulting electrical and refrigerating engineers. Messrs. Lyon & Crosbie are at present carrying out a number of experiments with a new refrigerator, of which they are the inventors and patentees.

Personal.—Mr. T. H. Harvey has been appointed London traveller for Johnson & Phillips' electric cable works in the place of Mr. McKrell, whose connection with this firm ceased as from the 31st ulto.

Promotion of an Electricity Company.—At the Stowmarket County Court last Friday Mr. F. A. A. Rowland, of Hitcham, brought an action against Messrs. Peddar & Prentice, of Stowmarket, for alleged services in the formation of a company called the Suffolk Electricity Supply Company. Mr. F. C. Peecock, on behalf of the defendants, put in a writ of prohibition, which had been granted by the High Court, to prohibit a jury in the County Court from proceeding with the action.

Rating of Machinery.—The Market Harborough Assessment Committee recently increased the net rateable value of six hosiery factories from an aggregate of £880 to £2,082. The firms attacked, being members, entrusted the conduct of their appeals entirely to the Machinery User's Association. An appeal to the Leicester Quarter Sessions resulted in a reduction of the total assessment from £2,082 to £947, and the Court refused to state a case for the Superior Courts.

Smoke Nuisance.—Last week the Metropolitan Electric Supply Company were summoned by the Paddington Vestry at Marylebone, for allowing black smoke to issue from their Amberley Road station. A penalty of £5 with 10 guineas costs was inflicted.

The Training of Electrical Engineers.—With this title the Electrical Standardising, Testing, and Training Institution have issued a pamphlet dated August, 1898, in which are set forth some notes for consideration by those desirous of entering the electrical profession, to guide them as to the best course of training. The advantages to be derived from a course of instruction at Faraday House are enumerated. A list is given of the companies and engineers associated with the institution in whose factories or works students may engage for a portion of their course in practical work. The pamphlet before us gives a number of photographic views of the various departments at Faraday House, and some of the lighting, electrical engineering, and railway works referred to.

ELECTRIC LIGHTING NOTES.

Acton.—Previous to the meeting of the District Council last week, Prof. Ayrton attended and had a long conversation with the chairman. He had visited the district in order to prepare a report on electric lighting.

St. Anne's.—The Urban District Council last week discussed the electric lighting question, and decided not to transfer the powers granted them under a provisional order, but to take the advice of an electrical engineer on the subject.

St. Austell.—We understand that the somewhat primitive electric lighting plant installed here is still meeting the demands of the residents. The directors are, however, contemplating taking out the old steam plant, and laying down a gas producer plant with gas engines in anticipation of a larger revenue than heretofore.

Bangor.—At a Local Government Board inquiry just held relative to an application by the Council for sanction to borrow £13,500 for carrying out an electric light scheme, and £650 for the purchase of land, it was stated that over 100 of the principal ratepayers have promised to take the electric light, while to meet any possible deficiency on the works, about 60 tradespeople, professional gentlemen and others, have signed a guarantee of £650 per annum.

Battersea.—The London County Council has decided to give consent conditionally to the frontage of buildings proposed to be erected by the Vestry of Battersea in connection with their central station for the supply of electricity, on a site abutting upon Lombard Road, Holman Road, and Harroway Road, as shown on the plan submitted by Mr. C. S. Peach.

Bengal.—An Indian exchange says that almost all the jute mills are now lighted with electric light, and the special inspector reports that, with two or three exceptions, mills that had previously opposed its introduction have since been compelled to give way by the necessity of competing with their neighbours, and retaining their hands, who otherwise would be attracted by the slightly higher wages they could earn by longer work elsewhere.

Bognor.—At a meeting of the Urban Council on Friday a report was submitted by the Electric Light Committee, recommending the Council to take the necessary steps to obtain an electric lighting order for the town, and that Messrs. W. T. Chadwin and W. T. Pressland be engaged as engineers at a nominal fee. The chairman said that if the gentlemen who were endeavouring to bring about electric railway communication between Bognor and Chichester were successful in their efforts, it might be found much cheaper to carry out the electric lighting of Bognor. After consulting with the engineer in private the resolution was carried, one member not voting.

Bournemouth.—The 4th Hants Head Quarters Drill Hall near East Station is being lighted throughout with electric light by Messrs. H. G. Andrews, electrical engineers, of Boscombe.

Bowness-on-Windermere.—At a recent meeting of the District Council an application was made by Mr. Fowkes, manager of the Windermere Electrical Supply Company, to lay cables under the footpaths, and also to build a transformer chamber in St. Martin's Square. The Council wishes to lay cables as far as possible within the Council's district, as many persons are asking for current. The Council consented to the work being done subject to the Postmaster-General's approval.

Buxton.—The Board of Trade has approved of the Council's electric lighting scheme, and it is hoped that the town will be lighted by electricity by June next.

Cheltenham.—At a special meeting of the Cheltenham Town Council, which was held on Monday afternoon, October 24th, to consider the question of applying to the Board of Trade for an amendment of the Cheltenham Electric Lighting Order, 1890, by extending the area of supply described in the first schedule to the said order to the whole of the said borough, or such part or parts thereof as may be determined on. Alderman Norman (chairman of the Electric Lighting Committee) said that since the lighting order had been passed, the area of the borough had been extended on the Leckhampton and Charlton side, and the object of their present application to the Board of Trade was to obtain powers to carry their mains and supply current within the added area. Councillor Lenthall seconded the adoption of the Lighting Committee's report, which was carried.

Cleckheaton.—The District Council has decided to oppose the application of the Electrical Power Distribution Company for a provisional order authorising them to distribute electrical energy within the Council's district.

Clontarf.—The Commissioners recently received a letter from the Acetylene Gas Company stating they understood the Commissioners were considering the advisability of lighting the township by electricity, and asking the permission of the board to erect some of their lamps in the township with a view of showing the value of acetylene gas for public lighting. The secretary is writing to the company for further information.

Coatbridge.—Bailie Lavell, the convener of the Lighting Committee, in addressing his electors a few days ago referred to the lighting of the streets. He stated that the contracts with the gas and electricity companies had again been entered upon for the year. After explaining that the House-to-House Electricity Company had declined to lay their main cables to the Whifflet and Coatdyke districts as it would be unremunerative, the Bailie said there was only one method by which they could extend the lighting area, and that was for the Corporation to buy up the electricity company, and he was prepared to bring up the proposal immediately before the Council. In the first place, the company in Coatbridge was not a paying concern, and never had been, but he believed the moment it became a Corporation concern it would begin to be profitable, as many more consumers would take advantage of the light. For public lighting alone they paid annually a sum which would pay 3½ per cent. on £24,000, and £24,000 he thought would buy up the whole concern to-morrow.

Cork.—The proposed scheme for lighting the Cork Lunatic Asylum by electricity has occupied the attention of the Board of Governors for some time, and a special committee was appointed to obtain full information and to ascertain the relative cost of gas and electricity. That committee met on Tuesday last to consider the report of Mr. Edmundson, the expert recommended by the Board of Control. The proposals of the Cork Electric Tramways and Lighting Company and the Cork Gas Consumers' Company were laid before the meeting. The figures drawn up by the committee showed the annual cost of gas at about £300 below that of electricity, and the committee recommends the continuance of gas lighting.

Croydon.—About two years ago the Croydon Corporation entered upon its electric lighting enterprise, and decided to supplement the old method of street lighting by a number of powerful arc lamps. The experiment proved so successful, and there was such a demand from private consumers, that the Corporation decided some months ago to largely extend its operations, and the result is the enlarged installation which has just been completed. The electric light works at Factory Lane have been considerably enlarged, and new plant of the most approved type has been laid down to supply the current for something like 16,000 more 8-C.P. lamps. The building at Factory Lane has been practically doubled, the cables have been extended as far as South Norwood and Upper Norwood, and the machinery has been added with a view to future requirements. When the works were originally constructed, three boilers were put in capable of evaporating 6,500 gallons of water an hour. Two more of the same capacity have now been added, and in place of the three sets of dynamos of 250 H.P. each, with which operations were commenced, two sets of dynamos of 450 H.P. each have been bought. The old plant was capable of supplying 12,000 8-C.P. lamps; the new plant will provide for 28,000. The extension of the cables has necessitated more sub-stations, and four new sub-stations have been added

in Croydon, and two large stations at South Norwood and Upper Norwood. Extensions have also been made to the switchboards, and entirely new switchboards have been provided for the Norwood stations. For Croydon, the current is run to the sub-stations at a pressure of 2,000 volts, and from the sub-stations this is reduced and distributed to the houses at a pressure of 200 volts, on the two-wire system. Special cables have had to be laid for Norwood, and great care has been taken in laying them, as, owing to the distance, the current will be supplied to that part of the borough at a pressure of 5,000 volts, and will be distributed from the sub-stations on the three-wire system at a pressure of 400 volts. The capacity of the transformers at the Norwood sub-stations is 100 kilowatts. The economiser has been added to, and a new feed pump has been put in, with new condensing plant. Owing to the hardness of the Croydon water, it has been found necessary to erect apparatus for softening it, and the hardness of the water is reduced from 80° to 5°. The new engines are three-crank instead of two-crank, and numerous minor alterations have been effected, so as to carry the efficiency of the works to the highest possible degree. An experiment is now being made with enclosed arc lamps, several of which have been erected in the streets, and so far they have proved a great success. The large arc lamps now in use burn for 12 hours without trimming, but the enclosed arc lamps last for 50 hours without attention, and there is a sanguine expectation that they will prove much cheaper than the others. The engineers consider that Croydon is exceedingly well supplied with current, and that no other town of the same size is so well served, the cost per unit also being agreeably low. On this point the authorities of the Parish Church, Croydon, where electric light has quite superseded gas, calculate that there is a saving of 25 per cent. on their lighting bill.

Last week the Board of Guardians considered the report of the committee appointed to consider the advisability of adopting electric lighting for the Union establishments. In view of the necessary heavy initial capital expenditure, the committee asked for the help of an expert. The committee had considered the report from Mr. Minshall, the electrical engineer to the Corporation, as to the cost of plant and of maintenance. The Board authorised the committee to employ an expert for the purpose.

Detroit's Municipal Lighting.—In their report for the year ended June 30th, 1898, the Detroit Public Lighting Commission state that the period in question is the first fiscal year in which a municipal lighting plant of any size has had as near a thorough test as possible, and the results are awaited by those interested for and against an institution of its kind. The physical results—that is, the conversion of fuel and water into electric current—for the year will bear comparison with the results of any plant, commercial or otherwise, generating electricity. The results from labour will not compare as favourably for the reason that slightly higher wages are paid and much shorter hours of work obligatory. The Commission considered, says *Public Opinion* of America, that the plant, operated under its enforced conditions, should produce an arc light of 2,000 candle-power at $50 yearly, and the heads of departments were instructed accordingly. By these economies the Commission was able to reduce the cash outlay per lamp from $64.19 per annum for a monthly average of 1,564 lamps for the preceding year, to $51.85 per annum for a monthly average of 1,744 lamps. The reduction was largely in the item of labour, being reduced from $43.57 per lamp to $33.27 per lamp, while the reduction in the cost of supplies was from $20.62 to $18 58 per lamp. While it is possible that improvements in some machinery may be made soon, which would cause a partial loss to the city of the value of part of its investments in machinery, on the other hand, it is only fair to state that there is an equal probability of compensating improvements in other devices, and which will enable the city to further reduce the cost per lamp per year. The ultimate success of the plan of municipal ownership of a public lighting plant, viewed from the standpoint of economy to the taxpayer, can not as yet be claimed to be assured in the city of Detroit. Time is an essential element of consideration in arriving at a judgment at all valuable upon this question. The margin of profit per lamp at the present time, while it is not large, nevertheless is a showing to the advantage of the city, which it is to be hoped will be maintained or increased in the future. It is but just to observe in this connection that the quality of light furnished has been uniformly of the full standard of 2,000 candle-power, which is better than was found practicable to obtain of contractors; and also that collateral advantages not easily reducible to terms of pecuniary value have accrued to the city by reason of its operation of its own lighting plant. The results, such as they are, have been secured by the commission only by the practice of the strictest economy and the rigid exclusion of all of those elements so apt to intrude into the administration of public municipal affairs, and which operate only to confound business principles and political expediency in perplexing entanglement. It has not been at all times easy to persuade some that these two principles occasionally clash irreconcilably, and in the determination of the one or the other to be followed, it was the duty of the commission to be guided solely by the interest of the taxpayer.

Dewsbury.—Application is to be made to the Local Government Board for sanction to a £9,060 loan for electric lighting purposes, including the necessary arrangements for giving a supply at higher voltage, the extension of mains in Oxford Road, West Park Street, James Street, and Park Road, the purchase and erection of an additional steam dynamo, the extension of the engine house, also house connections and services for two years ahead (estimated).

Ealing.—Several consumers wrote to the District Council *re* the failure in electric light supply, and the engineer reported to the Electric Lighting Committee that the failure was caused by an accident to machinery, which compelled him to shut down for about 10 minutes whilst the repair was done.

Farnham.—The District Council have instructed Mr. F. J. Warden-Stevens to prepare a report on the electric lighting of the town.

Festiniog.—A special committee will consider the report of Mr. Williams, surveyor, on the proposed electric lighting of the town.

Gorton.—At a special meeting last week the Urban District Council resolved forthwith to apply for a provisional order for the supply of electricity within their district.

Grays.—The Parish Council has resolved to engage Mr. A. H. Preece to draft an electric lighting scheme. A provisional order will be applied for.

Hanwell.—A resident having offered to defray the cost of the Council applying for a provisional order for electric lighting if it will afterwards transfer it to him, he has been told that when the district requires the electric light the Council will do the work itself.

Hastings.—Last week a Local Government Board inquiry was held here relative to the proposal of the Corporation to borrow £58,000 for the purposes of acquiring the electric light company's undertaking. Mr. Macmorran, on behalf of the company, explained that the company was incorporated in 1882 with a capital of £50,000. The company was not anxious to sell, because they had had an exceedingly good year, and there was every prospect of continued prosperity. Since June 1st the Corporation had been doing the whole of the public lighting, and the question appeared to be as to whether the sum asked (£58,000) was an exorbitant one. Mr. Ben. F. Meadows, town clerk, detailed the negotiations between the company and the Corporation, and said he believed the authorised capital of the company was £50,000. He believed only £27,220 share capital had been subscribed. Prof. Robinson, whose advice was sought at the request of the Council, was of opinion that the undertaking was worth £50,000. Mr. F. A. Langham, chairman of the electric lighting company, was of opinion that the Corporation would have a very good bargain. The price the company originally asked was £60,000, but it was subsequently reduced to £58,000. Mr. W. Andrews, the manager of the electric light works, said the whole of the plant, with the exception of a few pumps, had been put in since 1890, and was in as good a condition now as it was then. Mr. Hammond, consulting engineer, valued the goodwill at a much higher rate than Prof. Robinson did.

Heston and Isleworth.—The Water and Lighting Committee of the Heston and Isleworth District Council have recommended that the application of the Electric Power Distribution Company for an order to light the district by electricity be opposed, and that the Council take steps to determine if it would be advisable to obtain a provisional order themselves. The Council on Tuesday adopted the recommendations.

Huddersfield.—In the minutes of the General Purposes Committee adopted at the last Council meeting was a recommendation that the borough electrical engineer, borough engineer, waterworks manager, and tramways manager be instructed to report upon the practicability of utilising the water in the Wessenden valley for the purpose of generating electricity for traction or lighting purposes, and that they be empowered to obtain such expert opinions as they, in consultation with the Mayor and town clerk, may deem necessary.

A recent failure of the light is stated by the chairman of the Electric Lighting Committee to have been due to the breakdown of two transformers in the Market Place.

It is proposed to wire and fit up the Zion Methodist new connection Sunday Schools at Lindley for electric lighting. Tenders are being invited for the erection of the buildings, &c., and electrical engineers can obtain particulars of the electrical work from Messrs. Kirk & Sons, architects, Huddersfield, until November 3rd.

Hull.—On Tuesday the new electricity station in Sculcoates Lane was formally inaugurated by the chairman of the Electric Lighting Committee to supply a large portion of the city west of the River Hull, and outside the old town. The cost of the new station has been about £40,000, and there are nine miles of new mains. Four steam dynamos of 760 H.P. have been provided, and these will supply a current at 2,000 to 2,500 volts. There are two transformer sub-stations in Albion Street and Argyll Street.

Islington.—At last week's Vestry meeting when the item of £1,668 odd for electricity to public lamps came up to be passed, there was a brief discussion on the charges for current. It was stated that the Works Committee is about to reconsider the whole question of price, and there will probably be a considerable reduction to consumers.

The Library Committee has been considering what plant is necessary for the electric lighting of the library, and tenders are to be invited. The wiring is being proceeded with.

Itchen.—The District Council has deferred the application for a provisional order for the present.

Kensington.—The Special Electric Lighting Committee last Saturday recommended the Vestry to apply to the Board of Trade for a provisional order for the district. The Vestry's solicitors are to prepare the necessary memorial if the Vestry approves of the application being made.

Kidderminster.—The *London Gazette* of 25th inst. contains a notice to the effect that the Kidderminster Council proposes to transfer its electric lighting order to the Kidderminster and District Electric Lighting and Traction Company.

Kingswinford.—Several local authorities in the Black Country have been discussing, with closed doors, the question of the supply of electric light and power. The Kingswinford Rural Council are quite in advance of their neighbours, however, for they have not only already obtained a provisional order, but they have arranged with one of the leading electric companies for an electric installation in their district. The British Electric Traction Company, who are doing a great deal of electrical work in the Black Country, are going to carrying out their future works themselves, and not let the same to contractors.

Lane End (near Wycombe).—A movement is on foot for the lighting of this village with 32-C.P. lights. The light has already been installed at the chair-making factory of Mr. R. Smith, who has had a large dynamo fixed in his engine house, and he has approached the local authorities on the matter.

Larne.—On Friday, 21st inst., the streets of Larne and a number of business places were left in complete darkness for a short time owing to the failure of the electricity supply. Shopkeepers and others who depended solely upon electric light were inconvenienced.

Leatherhead.—The District Council is inviting offers until November 21st from parties desirous of taking over the provisional electric lighting order for a term of years. The order is on inspection at the Council's offices.

Leeds.—Some points of difference which recently arose in regard to the purchase of the Yorkshire House-to-House Electricity Company's undertaking by the Corporation were satisfactorily arranged last week at a conference of the Parliamentary Committee and the directors of the company. When the necessary accounts can be made up and legally transferred, it is hoped that the purchase will be completed.

Lewes.—The question of the transfer of the Council's provisional order under certain conditions is to be considered by a joint Committee of the Council.

Llandudno.—It had been hoped that Mr. Chaplin would have been able to attend the opening ceremony arranged by the District Council, but as this is impracticable, it is proposed to defer the ceremony until spring next year. The Light Railways Company at Llandudno have written asking the Council if they are going to supply the energy, and at a meeting of the Council it transpired that if the Council decided upon this course, it would be necessary to have additional facilities, which would mean an expenditure of about £10,000. The Council referred the matter to the Electric Light Committee, who will have a special meeting to consider the matter at an early date.

London.—The Metropolitan Electric Supply Company has informed the Strand Board of Works that a reduction would in future be made in the company's charges for the various premises occupied by the Board.

Ludlow.—A copy of the application of the Ludlow Corporation for a provisional electric lighting order appeared in Tuesday's *London Gazette*.

Lye.—Mr. Warden-Stevens is to advise the District Council respecting the introduction of an electric supply scheme.

Manchester.—On 24th inst. a Local Government Board inquiry was held in the Town Hall into the application by the Corporation for sanction to borrow £200,000 for electric lighting. The deputy town clerk explained the proposals. He said the electricity undertaking of the Corporation had been in existence a little over five years, and at the present time there were 214,946 8-C.P. lamps connected, with 31,760 waiting to be connected. The Corporation was not yet in a position to connect this latter number, and would not be until additional plant now being constructed and authorised by the Local Government Board came into operation. The charges for the electric current at the present time were 5d. per unit fixed charge, and for long hour consumers 1½d. per unit, and £7 per annum per kilowatt. During the four years and eight months ended March last the Corporation had placed into the reserve and renewal funds £34,245, and had handed over to the City Fund £26,694, making a total of £60,939. That sum extended over four years and eight months was equivalent to a rate of more than 1d. in the £. The electricity undertaking of the Corporation had been a marked success, and it was interesting to note that whilst its success had been in progress the gas undertaking of the Corporation had been in no sense damaged. In fact, the Corporation in connection with their gas undertaking had been able to hand over to the ratepayers per annum sums of money which had been equivalent to a rate of more than 4d. in the £. There was a great community of interest in existence between the city of Manchester and the large number of urban districts surrounding the city, and that interest had existed for many years past in many shapes, as, for instance, in the supply of water and gas to these townships. From this feeling of mutual interest had probably arisen the demand that Manchester should also supply electric current to certain of these districts, and should undertake to provide for the working of the tramways. The Corporation had acceded to these demands, and the main object of the present application was to make provision for the districts of Levenshulme, Moss Side, and Withington. Negotiations were pending with other districts, and it was very probable that many arrangements would be entered into. He was instructed to state publicly that the price which the Corporation would charge for the electric current in the outside districts would be precisely the same as they were now charging, and would continue to charge, in the city. The money which they were now seeking to borrow was not required solely for present demands, but also to meet prospective requirements. The buildings and works included several sub-stations which were required as transforming stations, and a plot of land had been secured in Bradford, upon which a large new generating station was to be erected.—Alderman Lloyd Higginbottom gave evidence in support of the application, and said that the great expansion of the undertaking had rendered it absolutely necessary that the Corporation should obtain increased borrowing powers. The capital expenditure on the undertaking up to March 31st last was £356,617. Having given figures showing the extent to which the demand for the supply of current had increased since 1893, Alderman Higginbottom said that when the new generator was completed there would be plant available for 220,000 8-candle lamps. The number of lamps had increased during the past two years at the rate of 46,000 per year, and the present rate of demand was equal to, if not greater than that. The new applications for electric current averaged 12 per week. The average price charged for the current was one of the lowest in the kingdom, being 3·8d. per unit. The arc lights in the street were supplied at the low price of 2d. per unit, and future extensions of the arc light would be supplied at that price, or even less. The Committee had decided to recommend the Council to do away with the present charge for meter rents, and this would mean a reduction to the consumers of about £2,000 per annum. This would do away with what had been felt to be a hardship to small consumers.—Councillor J. Phythian and Mr. C. H. Wordingham afterwards gave evidence in support of the application, the latter gentleman explaining the proposed works in detail. There was no opposition to the application.

Mirfield.—Mr. W. H. Priestland has been engaged by the Mirfield District Council to take all necessary steps for obtaining a provisional electric lighting order.

Motherwell.—Last week the Police Commissioners had under consideration a scheme of electric lighting for the burgh recommended by their consulting engineer, Dr. Kennedy. The estimated cost of the scheme, allowing for contingencies, engineering charges, &c., is put down at between £23,000 and £24,000, which will provide private lighting, and also street lighting with 30 arc lamps and 400 32-C.P. incandescent lamps, and also a supply of motive power. The report was approved of.

Newbury.—A memorial from residents asking the Council to provide electric light, has been referred to the Gas Committee to report upon.

Newton.—The District Council has decided not to take in hand the matter of electric lighting at present, but to leave it to a private company.

Nottingham.—The applications for current during the past 12 months have been 670. The works are being considerably extended, and new mains being laid. At present the works are equal to 2,200 H.P., but by the end of the year 400 H.P. more will be added, and when the extensions are completed, there will be 7,000 H.P.

Petersfield.—Last month the Urban District Council, in spite of much opposition, resolved to apply to the Board of Trade for a provisional order for electric lighting, but a fortnight later thought it well, in deference to the wishes of a large number of petitioners, to first ask the gas company to give a tender for lighting with Welbach burners. Meanwhile a big ratepayers' meeting, convened by the lately revived Ratepayers' Association, was held, and the electric lighting proposal vehemently denounced. At the ordinary meeting of the Council on 20th inst. the gas company's tender was considered, and from a report we have received, it seems that they are to be allowed to continue to light the town with the new burners and leave the lamps alight half an hour longer each night at the same price as under the old system. The Lighting Committee has power to act.

Poplar.—The Local Government Board has replied to the Guardians that it will consent to the repayment of the loan for the electric lighting of the workhouse being spread, as to £3,000 over 30 years, and as to £6,000 over 15 years, or alternately the whole amount over 30 years.

Rawmarsh.—A member of the Urban Council intends to propose that a Committee be formed to consider and recommend to the Council the best means of lighting the compulsory area with electricity under the provisional order recently obtained.

Rugby.—The Urban District Council have issued the necessary statutory notices of their intention to apply to Parliament for a provisional order.

Russia.—A large new central station is being erected in the town of Kiew. The plant will comprise two Babcock-Wilcox boilers, two large steam engines, by Messrs. Schichau, of Elbing, Germany, and two 400-kilowatt dynamos by Messrs. Brown, Boveri and Co., of Baden, Switzerland.

Shoreditch.—Owing to increasing demand, the Vestry has given notice that it cannot guarantee to supply new applicants until after December 31st, when the additional plant, which will more than double the present output of the station, will be available.

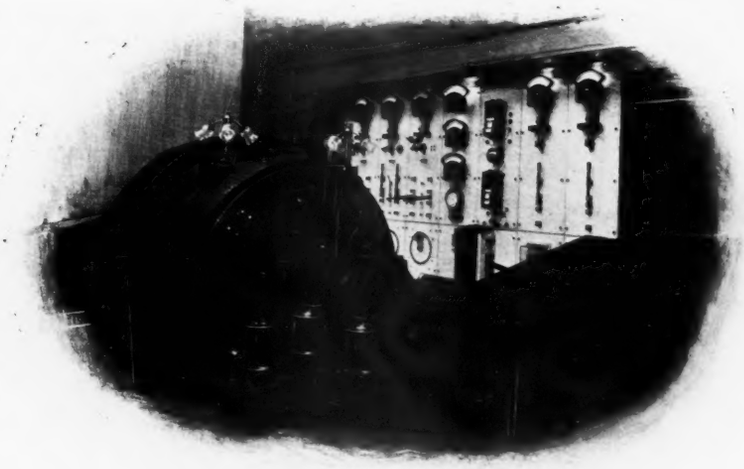
The Vestry Technical Instruction Committee is starting a class of instruction in the theory of electric fitting.

(*Continued on page* 637.)

THE GLASGOW MUNICIPAL ELECTRIC TRAMWAYS.

(*Concluded from page* 598.)

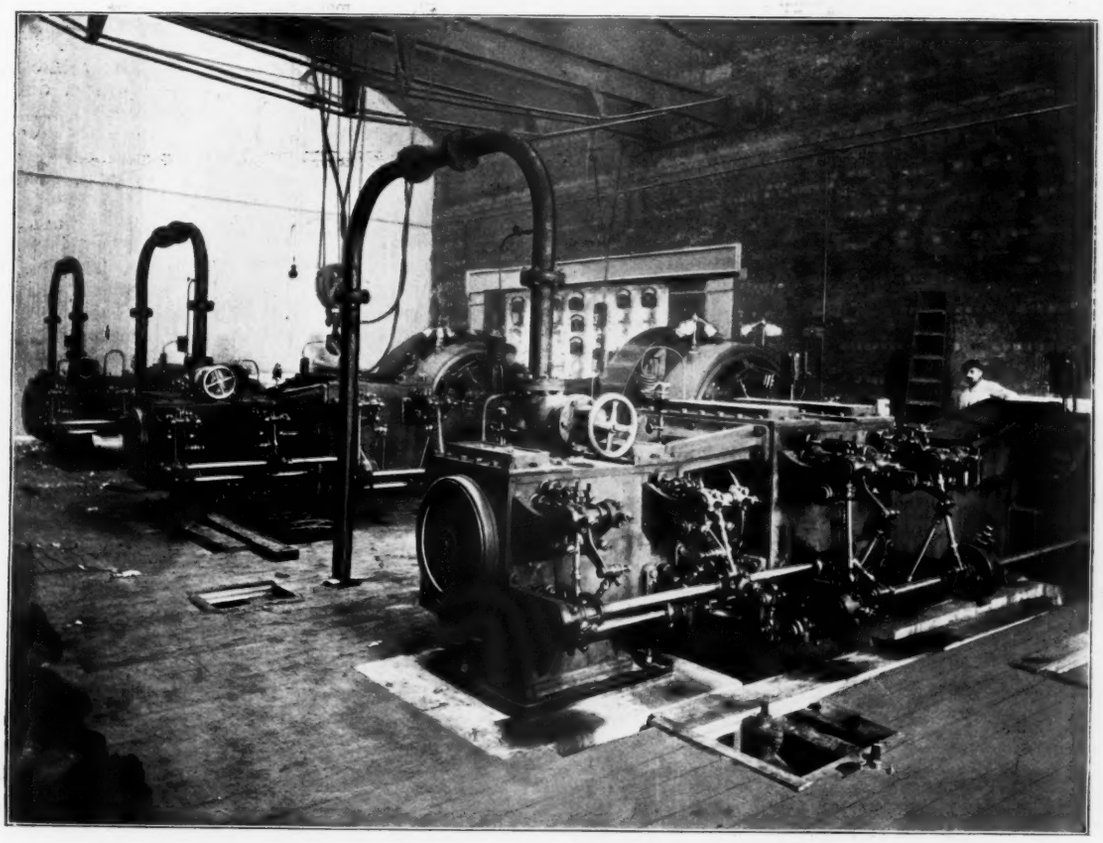
TAKING up the story at the point where we broke off last week, we will proceed to speak of the permanent way construction. In laying out the system fewer roadway difficulties have been encountered than arises in many towns, save for the incident of the St. Rollox railway bridge. The roadway is for the most part of considerable width, the narrowest portion along the entire route being 31 feet wide. At this point there may be occasional difficulties in operating quick traffic, because there is not sufficient road room outside the rails to accommodate ordinary vehicular traffic, consequently on two cars approaching each other from opposite directions, vehicles in order to avoid the on-coming cars will be compelled to follow the line of rails, and will thus tend to delay the car behind. It is stated that the shortest distance between the outside rail and the kerb at any point on the system is 8 feet, but our impression, a hasty one, however, would have made it about 6 feet, or even less than that near St. Rollox Bridge. The difficulties experienced in this direction, however, will serve to demonstrate the peculiar advantages of electric tramways.



GENERATOR AND SWITCHBOARD.

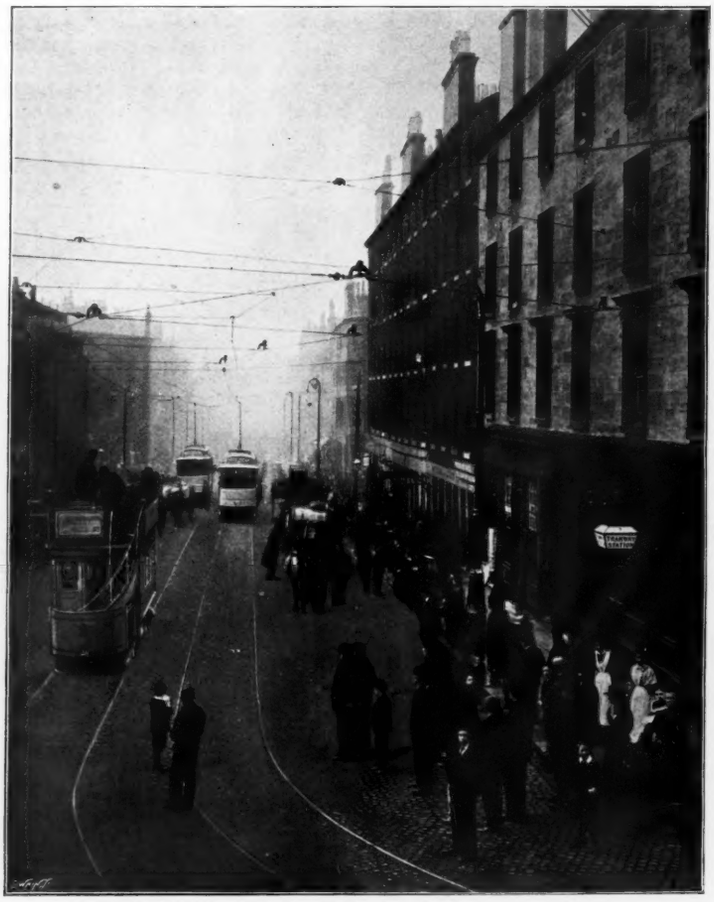
The permanent way construction does not differ from the usual practice employed at the present time. It is specially designed to meet the conditions of heavy traffic, and is in consequence of a very solid character.

First of all, the road was excavated to a depth of 1 foot 1 inch, and on this a layer of "Portland cement" 6 inches thick was laid; on this concrete bed the rails were laid, and then there followed a grouting of bitumen and granite chips. The roadway between the rails and for a distance of 18 inches on the outside of the rails is paved with granite setts. The



GENERAL VIEW OF ENGINE ROOM.

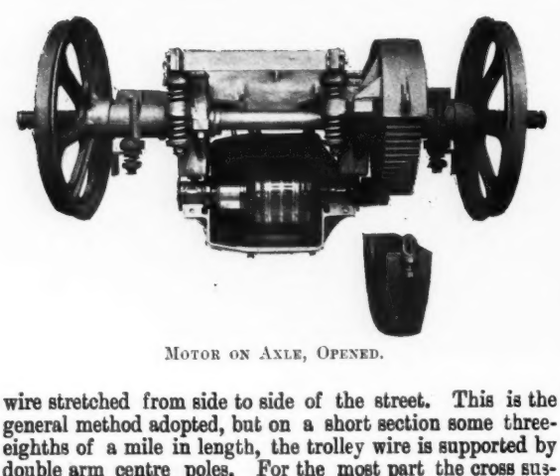
gauge of the track is 4 feet 7¾ inches, a girder rail weighing 100 lbs. per yard being employed. The chief measurements of this rail are that it has a depth of 6¾ inches, the width on head is 1⅝ inch on roll, 3¾ inches overall, while the width of the base is 6½ inches. They are made in 45 feet lengths, and were delivered by the makers ready drilled for bonds, the diameter of the hole being 1 1/16th inch. We understand that the advantage of as long a rail as possible being recognised by the makers, the latter portion of the track was equipped with rails of 60-feet lengths. The rails are held together by means of steel fish-plates, which weigh 48 lbs. per pair. They are 24 inches in length, and are provided with six bolt holes, the diameter of the bolts being 1 inch. At intervals of 7 feet 6 inches steel tie-bars are employed, the size of the bar being 2 inches by ⅜th inch. Drain rails are used at certain points. The rails are bonded together by means of Daniel bonds. They are double copper bonds of 0000 B. & S. gauge, the length of each bond being 2 feet 4½ inches. In addition, the rails are cross-bonded at intervals of 135 feet, the diameter of the cross-bond wire being the same as that of the ordinary bonds.



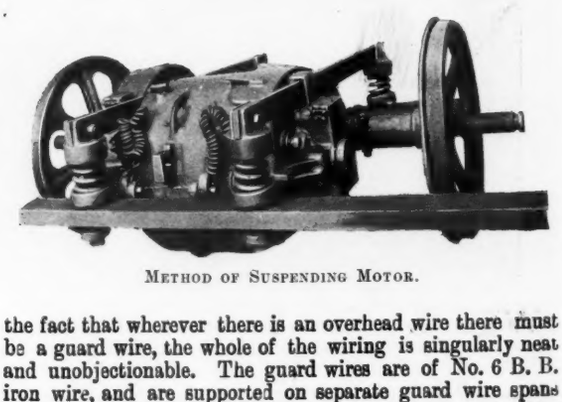
Cars in a Crowded Thoroughfare.

We made some reference in our last issue to the method of suspending the overhead wire. It will be remembered that the system is that known as cross suspension, the trolley wire being held centrally over the track by means of strand wire stretched from side to side of the street. This is the general method adopted, but on a short section some three-eighths of a mile in length, the trolley wire is supported by double arm centre poles. For the most part the cross suspension wire is attached to posts placed at the edge of the kerb. They are fixed at an average distance apart of 120 feet, the total length of pole is 31 feet, and they are sunk in the ground to the extent of 6 feet 6 inches. The poles were drawn by the National Tube Works Company, of Dock House, Billiter Street, London, from extra heavy mild steel pipe composed of three sections. They were raked away from the vertical about 8 inches to allow for the strain on the span wires. The span wire is supported to the side poles through the intermediary of an insulator by means of an iron ring. At certain points along the route the side poles have been displaced by ornamental rosettes attached to buildings by means of four Lewis bolts. The span wires are supported in a kind of barrel arrangement from which they are insulated, moreover the support for the wire is insulated from the building.

Through the courtesy of Mr. Blackwell we are able to give drawings showing the details of the rosette. The trolley wire is, of course, double throughout, and consists of 00 B. and S. gauge copper, having a conductivity of 98 per cent. and a breaking strain of 6,000 lbs. The ears supporting the trolley wire are 18 inches in length, and are soldered to it. As the trolley on the car is of a somewhat rigid character, the overhead wire is necessarily made more flexible than is generally the case with the side bracket suspension; moreover, as the trolley pole has practically no lateral play, it is incumbent to place the overhead wire in the centre of the track. In such a case a somewhat large number of guy wires are necessary at sharp curves; but in spite of this and the fact that wherever there is an overhead wire there must be a guard wire, the whole of the wiring is singularly neat and unobjectionable. The guard wires are of No. 6 B. B. iron wire, and are supported on separate guard wire spans placed about 6 inches above the trolley. If it were not neces-

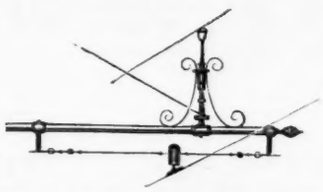


Motor on Axle, Opened.



Method of Suspending Motor.

sary to provide protection for telegraph and telephone wires, the overhead system would scarce be noticeable; as it is, to



Method of Suspending Wire to Bracket.

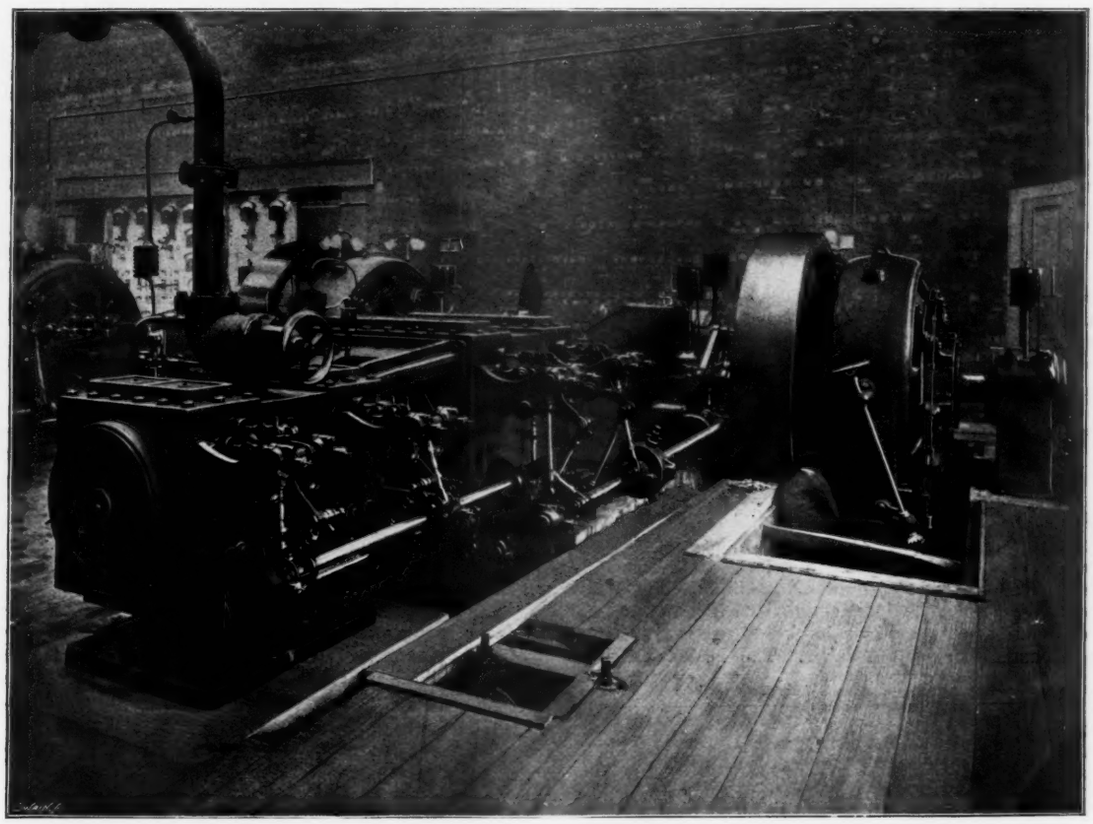
afford immunity from accident necessitates a double system of wiring throughout. A noticeable point of difference from English practice in overhead construction is in the method of suspending the trolley from the bracket arms. On the Springburn Road there is, as we have already mentioned, a short length of line where double arm bracket poles are used; from end to end these double arm brackets measure 11 feet 6 inches, and, as a matter of fact, project considerably beyond the centre of the track. The trolley wire is attached to this through the medium of a short length of cable arranged parallel with the arm; the precise method will, however, be seen on referring to the detail drawing. This arrangement obviously gives more flexibility than is obtained when the trolley wire is rigidly attached to the arm. The whole of the overhead work has been done for the Westinghouse Electric Company by Messrs. Macartney, McElroy and Co., of London and New York.

In accordance with the Board of Trade regulations, the line is divided into half-mile sections, which are fed from section boxes that are connected to the feeders.

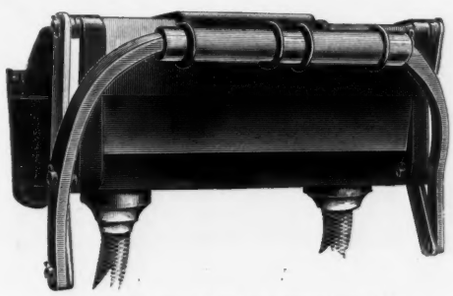
The section boxes are of cast-iron, the main cables being brought up from the conduits to the switches inside. In each section box there is a telephone, a set of lightning arresters is also provided for protecting the cables from lightning. Each main feeder is also protected by fuses. The leading-in wires between the section boxes and the trolley wire are led down from the section box in a separate conduit to the nearest pole, and then up the pole and out on the suspension wire to the trolley wire.

The feeders are placed underground, and have a section of ·5 square inch. They were manufactured and laid by Messrs. Siemens Bros.

The power station is situated within half a mile of the northern terminus of the line, and adjoins the car sheds. There is, apparently, ample room for extensions, and one of the end walls is of a temporary character, and consists of corrugated iron. A chimney 100 feet high has been erected, and will, no doubt, accommodate a good deal larger plant than is at present provided. The boiler room is by no means large, being 46 feet wide and 33 feet in length. There are at present erected two Babcock & Wilcox boilers, each of which will develop 250 H.P. They have a heating surface of 2,530 square feet, and a grate area of 51 square feet and are designed to evaporate 7,500 lbs. of water. Vicar's automatic stokers are employed. The whole of the steam pipes are in duplicate, and the appearance of the engine room is improved by them being placed under the floor. The exhaust steam passes into a Worthington condenser, with water circulating round it, and is then



View of Engine and Generator.

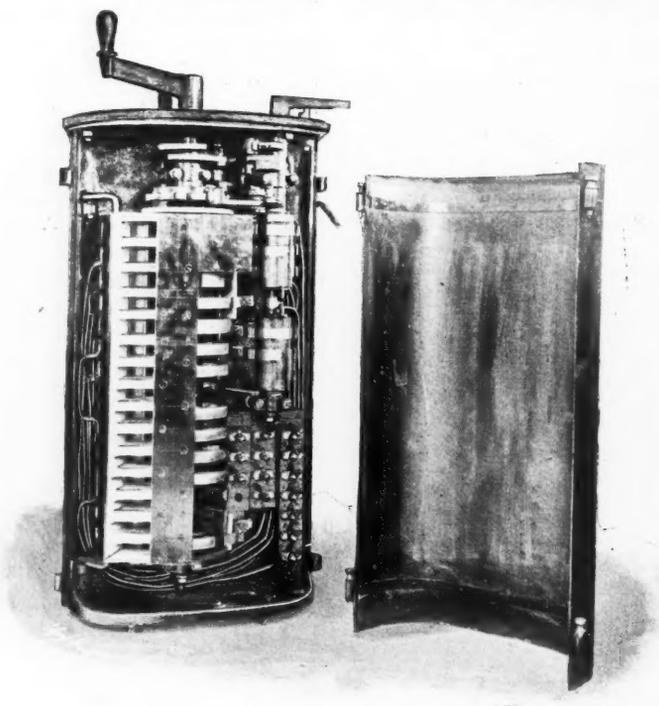


Fuse Box Closed (See box opened, p. 637).

cooled in a Worthington cooling tower. If necessary, exhaustion to the atmosphere can be easily effected. The water, both for boilers and condensing purposes, is obtained from the city mains.

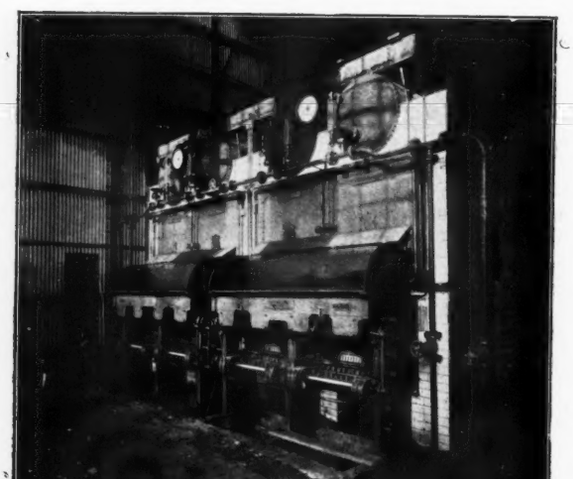
It is, perhaps, worth while to give a short description of the condensing apparatus. It consists of horizontal combined air and circulating pumps in connection with a surface condenser. The steam cylinders which drive both air and circulating pumps are compound.

The condenser may be said to consist of two parts: the condenser in which the exhaust steam of the main engine or engines is condensed, and the tower in which the heated discharge water from the condenser is cooled to proper temperature, to be used again in the condenser for the further condensation of the exhaust steam. As this process is carried on continuously, only a very small supply of circulating water is required.



Westinghouse Controller.

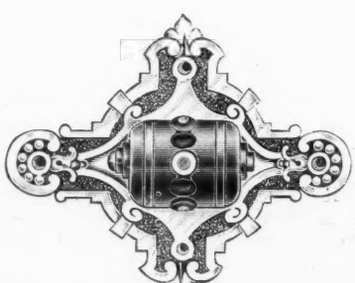
The tower consists of a cylindrical steel shell open at the top, supported upon a suitable foundation, and having fitted at one side a fan, the function of which is to circulate a current of air through the tower and its filling. This filling consists of layers of cylindrical tubular tiling, which rests upon a grating supported by a brick wall extending around the circumference of the tower. The heated discharge



View of Boilers.

water from the condenser enters the tower at the side, passes up the central pipe, is delivered on the upper layer of tiling and over the whole cross-section of the tower by a distributing device consisting of four pipes, which are caused to rotate about the central water pipe by the simple reaction of the jets of heated water issuing from one side of each pipe after the manner of a Barker's mill. The water thus delivered spreads over the outside and inside surfaces of the walls of the tiling, and forms a continuous sheet, which is presented to the action of the air. The tiling are placed on end in horizontal layers, one upon the other, and packed as closely as possible, the walls of each individual tile of each successive layer being disposed so as to come opposite the air spaces of the next lower layer, breaking joints, as it were, the object being in this disposition to break up both the currents of air and water, so that the most thorough and extended contact will take place. If there are ten layers of tiling in a tower, then there are nine places, in addition to the original spreading at the top, at which there is a complete redistribution of the water. It will be seen that each tile must rest on at least two, and possibly three, in the next lower layer. Assuming, however, that each tile rests on only two others, a given quantity of water, placed on any one tile in the top layer, will be divided over at least two tiles in the second layer, three in the third, four in the fourth, and so on, until it becomes spread over 54 in the lowest layer on the grating.

The air is distributed in an equally good manner, and there is a large, free area with equal facility for its passage upward over the entire cross-section of the tower. The heated water falling through the tower is cooled by three processes: first, radiation from the sides of the tower; second, the contact of



Wall Rosette.

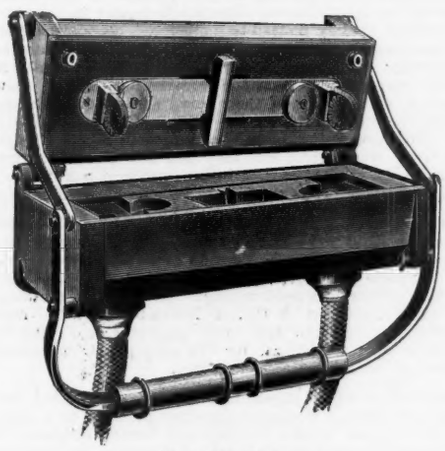
cool air; and third, evaporation. This latter is by far the most important, as the evaporation of a pound of water in this way carries off about 1,000 units of heat, and enables a pound of steam to be condensed in the condenser. As quite a proportion of the cooling is done by the first two processes, the evaporation of water in the tower must be less than the water formed by steam condensed in the condenser. Consequently, the supply of circulating water is constantly augmented, and requires no replenishing. The cooled water falls from the grating to the subsiding tank at the bottom, and is from there drawn by the condenser to perform condensation again.

The tower which has been supplied to Glasgow is 12 feet diameter and 31 feet high. It is filled with vitrified fireclay pipes, and is provided with a fan 84 inches diameter, to circulate the air through these pipes in contact with the warm water coming down from the distributor at the top.

The engine room is 61 feet in length and 36 feet in breadth. There are already in position three sets of plant, which consist of M'Intosh & Seymour engines of the horizontal tandem compound type, direct coupled to Westinghouse generators. At 200 revolutions per minute each of these engines will develop 300 H.P. The following are the principal measurements :—H.P. cylinder, 11 inches, L.P. cylinder, 22 inches, and the stroke is 24 inches. They are governed by a fly-wheel governor placed on the expansion valve of both cylinders.

As we have said, the generators have been built by the Westinghouse Electric and Manufacturing Company. They are of the standard railway type, compound wound, being over-compounded 5 per cent. to allow for variations in engine speed and loss on main feeders. Compensating cables between the generators are not taken to the switchboard, but in every case there is a separate pedestal switch close to each dynamo. The generators are reputed to have an efficiency of 94 per cent., the combined efficiency of engine and generator is given at 85 per cent. The details of the tests made show that the plant had to run 24 hours at full load, and for half an hour at 50 per cent. overload.

The switchboard is of the standard Westinghouse pattern; there are three generator panels and four feeder panels. In the centre of the board is a panel set apart for the Board of Trade instruments and the main recording instruments. At the back of the board the rheostats for the generators are placed, and are connected through the marble panels to a shaft operated by a wheel in front. The main ammeters and voltmeters are all of the Weston type.



Fuse Box Open.

At the back of the board the bus bars and the main terminals are so arranged that the board can be added to indefinitely without any alteration in the existing arrangements.

There is no woodwork or combustible material employed in connection with the manufacture of the board, the instruments being mounted upon marble slabs in a framework of angle iron.

It now becomes necessary to refer to the rolling stock, which, as may be judged from the illustrations, possesses some rather novel features. The equipment for the present line is to consist of 25 cars, 21 of which are to be single-deck type, and four are to be provided with outside seats, the latter being in the nature of an experiment. The majority of the cars are 33 feet 6 inches in length, and the entrance is in the centre, the vestibule dividing the vehicle into two portions, one of which is reserved for smokers, the only penalty attaching to smoking being that there are no windows, waterproof blinds being provided to protect passengers from wet. These cars are mounted on double bogies, which have a wheel base of 4 feet, the wheels being of chilled iron and 30 inches in diameter. The height of the cars inside, from the floor level, is 7 feet 9½ inches, ventilation being secured by the monitor roof, which is furnished with side panes. The seating capacity of the large cars is 50 passengers. The double-deck cars are a good deal shorter than the double-bogie cars, and have a wheel base of 6 feet. The Westinghouse Company have supplied the electrical equipment for most of the cars, though we believe that supplied by other makers does not differ materially from it. The Westinghouse apparatus for each car consists of two 39 Westinghouse motors each of approximately 35 H.P. A series parallel controller is placed at each end of the car, and the chief feature of this is that it is possible by it to make the motors act as an electric brake. This is done by the handle being reversed to its fullest extent, and thereby engaging in a gearing which brings into operation a second spindle shown at the right-hand of the controller; this immediately has the effect of reversing the flow of magnetism in the armature of the motors, and causes them to exert a pulling effect on the wheels. The motors, in fact, become generators, and the current so produced is taken up by resistances. By increasing and decreasing the amount of resistance in the circuit, the braking action may be regulated at the will of the driver. There are also on the cars a main motor circuit switch, automatic circuit breaker, a cut-out, and lightning arrester.

The main fuse of the car is an ingenious arrangement. We have illustrated the box in which it is carried. The fuse consists merely of a copper wire placed in position in the box, and upon the lid being closed, two copper bands, carried on discs, the edges of which are shown projecting from the box lid, are jammed on to it. When the fuse is blown the lid is pulled open by the handle shown, and the two ends of the fuse are usually found adhering to the copper bands. The chief feature is the ease and rapidity with which a fuse can be replaced. Each car is fitted with a Vandorn coupler and the usual pedal sand box; there is, in addition, a collision fender made of angle iron, and a life guard in the form of a wire cradle.

It is proposed that the service of electric cars shall be one of 2½ minutes, and fixed stopping places being arranged every 220 yards, the average speed per hour, including stops, being 7 miles.

It should be mentioned that the work has been carried out to the plans and under the supervision of Mr. John Young and Mr. Clark. As we have already pointed out, the principal contractors for the work were the Westinghouse Electric Company, Limited, and the principal sub-contractors were Mr. Robert Blackwell, Messrs. Macartney, McElroy & Co., and Messrs. Siemens Bros.

ELECTRIC LIGHTING NOTES.

(*Continued from page* 632.)

Stourbridge.—Last week the Urban Council appointed the "Electric Powers Committee" to promote the application for a provisional order for electric lighting, with power to employ and consult an electrical engineer for the purpose.

Swinton.—The Swinton and Pendlebury District Council have decided to promote a provisional order for supplying electricity for lighting and tramways. A Committee has been appointed to instruct the Parliamentary agent to proceed with the order.

Tobermory.—The Burgh Commissioners have received a letter from the Acetylene Gas Generator Company with reference to the lighting of the borough, but will allow it to lie on the table meantime pending a consultation with Mr. Yorke, electrical engineer, as to the advantages of the electric light. Mr. Allan, of Aros, has arranged with Mr. Yorke for an installation of the electric light at Aros House, Baliscate House, and the residence of Mr. Weston, the estate manager, at a cost of £700.

Totnes.—Messrs. Handcock & Dykes, electrical engineers, of Westminster, who intend to acquire the Totnes town mills and their water supply for electric lighting to supply the town, have approached the Town Council, who have agreed not to oppose the firm obtaining a provisional order, subject to conditions being mutually arranged.

Uckfield.—On Monday evening the Uckfield Rural District Council had before them an application from the Crowborough Gas Company for resolutions to be passed by that body favouring the company's endeavours to obtain a provisional order for powers to supply electricity throughout the rural district of Uckfield. The Council refused to accede to the request on the ground that it would give the gas company a monopoly throughout the district.

Warrington.—The lighting of the borough by electricity has been under the consideration of the Sanitary Works Committee and the Electric Lighting Sub-committee, and Mr. A. H. Preece has been requested to prepare a scheme.

Wellingborough.—The Highway Committee recently recommended the Council to consider the question of a refuse destructor with a view to using the same for electric lighting, but the Council last week deferred the consideration of the matter, it being stated that very shortly the town would have to provide for dealing with the refuse.

Weston-super-Mare.—It is understood that subject to the approval of the Council it has been agreed by the Lighting Committee to lease a provisional order to the Electrical Power Distribution Company for a period of 10 years, after which the Council will have the option of purchasing the electric light installation at a fair valuation on giving 12 months' notice. It is further stated that the price per fixed lamp is expected to work out at about 2½d. per Board of Trade unit, and a guarantee is arranged for that the total cost shall not under any circumstances exceed 2½d. For private lighting the charge will, it is said, be 8d. per unit for the first hour and 2d. afterwards. All specifications, plans, and machinery, &c., are to be approved by the consulting engineer, the company agreeing to pay all the costs hitherto incurred in obtaining the provisional order and any fees due to the consulting engineer. These are, briefly stated, the conclusions believed to be arrived at. It is thought that a local syndicate will possibly appeal to the Board of Trade, as they were first in the field for the town's provisional order, and it is also stated that the syndicate are prepared to offer as reasonable terms as any other negotiating parties.

Whitehaven.—It is stated that the electric lighting undertaking is making rapid progress. With the applications now received for current, the plant at the lighting station will be pretty well occupied during the winter. Five dynamos are already required, with a sixth as a stand-by. In the spring the recent purchase of adjoining property will be utilised for the purpose of extension. Two new boilers will be put in, and there will be a very considerable addition to the generating plant.

Wormit.—With reference to our note of October 14th regarding the lighting of Wormit, near Dundee, the British Illuminating Company, of Edinburgh, write as follows:—"As your notice conveys an erroneous idea, kindly allow us to state that the village is to be lighted in the first instance by a steam plant which will be complete in itself. Mr. Stewart, however, intends building a windmill, which will be used for charging the accumulators belonging to the installation, which will enable him to form an idea of its capabilities before going further in the matter. We might point out that he intends moving his works to Wormit, and the generating plant will be on his works, so that we may reckon on a very high plant efficiency."

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Brighton.—At the last meeting of the Town Council the General Purposes Committee reported the receipt of a letter from Mr. H. Reason with reference to an application by the British Electric Traction Company to the Board of Trade, for an order under the Light Railways Act, to supply electric tramways in a part of Sussex, including Brighton, and requesting an interview for representatives to discuss the matter. It was resolved that in the opinion of the committee the Council should themselves undertake the construction and working of tramways in the borough, and that Mr. Reason be informed that they do not deem it advisable to entertain the scheme of the British Electric Traction Company. It was further resolved that in the event of the above resolution being approved by the Council, the town clerk do communicate the purport thereof to all other companies and persons having submitted proposals for constructing tramways and railways in Brighton. Alderman Reeves, in moving the confirmation of the committee's proceedings, said they had resolved to oppose the company's application to the fullest extent, and for very many reasons. They had a strong opinion that the Light Railways Act was never passed with the intention of enabling companies desiring to make profit to go into towns, but to give outlying rural districts facilities for conveying goods to railway stations or some neighbouring town. They had also the strongest objection to any company obtaining the power to deal with the streets. There could be no question that if tramways were to come in Brighton the Corporation could give better facilities to the public. He took it that possibly they would not have moved so quickly in the matter as they were now prepared to do but for the applications from private companies. They could not act the part of the dog in the manger. These companies were putting them to great expense in defending themselves in the House of Commons, and no doubt the effect would be that next year there would be before the Council a definite scheme for tramways in Brighton. The resolution was agreed to.

Carlisle.—The General Purposes Committee has received a letter from Messrs. Pritchard & Co., Birmingham, containing the proposals of the promoters as to the construction of the tramways, and a deputation has waited upon the committee with respect thereto. The promoters ask for consent to the employment of the overhead wire system. The Council has referred the matter to Prof. Kennedy to report upon the different systems of electric traction.

Clontarf.—At a recent meeting of the Clontarf Commissioners letters were read from the Board of Trade, and their inspector, Sir Francis Marindin, relative to the application of the Tramways Company for permission to increase the speed of their cars on the Clontarf line. After some discussion, in the course of which it was remarked that 12 miles an hour during day time, and 10 miles an hour at night would not be regarded as excessive speed, it was ordered that the matter be again brought before the Board.

It seems that the Dublin Southern Tramways Company has asked the Board of Trade to hold a local inquiry on the subject of the speed.

Dewsbury.—The Corporation electrical engineer, Mr. O. M. Jonas, is preparing plans for a system of electric trams for the municipal borough and the districts of Heckmondwike and Ravensthorpe. Next month an application is to be made by the British Electric Traction Company, Limited, London, under the Light Railways Act, for powers to construct lines in the district. The Dewsbury Corporation, however, has decided to oppose the company and also to ask neighbouring authorities to join them in promoting a local scheme. The company's engineer has been in the district several times surveying, and the application is likely to be proceeded with. Powers are to be asked for to construct lines from Dewsbury to Cleckheaton, a distance of about 5 miles, in one direction; and also for Dewsbury to Ravensthorpe, a distance of about 2 miles in another direction. If the company's application is granted the overhead system will be adopted, and it is said the work will be proceeded with at once. The population of the districts through which the lines will pass is upwards of 100,000. There is a system of steam trams from Dewsbury to Gomersal, the distance between these two places being about 5 miles, and the local company has been approached by the British Electric Traction Company with a view to the latter taking over the concern.

Dudley.—A special meeting of the Dudley Town Council was held on Monday evening for the purpose of considering the proposal of the British Electric Traction Company to take over the tramway from Dudley Station to the borough boundary, electrically equip it, and so make a continuous electrically worked line from Dudley to Stourbridge. A communication was read from the company stating that they were desirous that the line through Dudley should be transformed with a view of their being able to supply a through service concurrent with the service through Brierley Hill to Stourbridge. The present, the company considered, was a most opportune time to do the work, seeing that they had now all the workmen and materials on the spot. The Stourbridge section, it was stated, would soon be completed. The Council gave its consent conditionally.

Italy.—In connection with the experiments with accumulator traction about to be carried out on the railway between Milan and Monza, La Società delle Ferrorie delle Mediterranea has just placed contracts with Messrs. Grondona, Corri & Co., of Milan, for two special railway carriages arranged to receive the battery, &c., with Messrs. Schuckert & Co., of Nuremburg, for the necessary electromotors, controllers, and other apparatus, and with Messrs. G. Hensemberger, of Monza, for the supply and maintenance of two complete batteries and accumulators.

Limerick.—The Corporation last week decided to refer the Limerick Electric Tramways Company's scheme to a committee of the whole house. Messrs. O'Connor and Dudley, solicitors, Dublin, have postponed their application for a like scheme, as nothing could be done until the Spring Assizes, and their principals did not think a tramway scheme would pay unless in conjunction with one for supplying electric lighting to the city.

Liverpool.—Pursuant to a resolution of the Tramways Committee, "That the city engineer report generally as to carrying out the reconstruction of existing lines and the construction of the new lines, authorised by the tramways order of 1898, for electric traction," Mr. Brodie has issued a report. He remarks that in connection with the construction of the new lines, and the reconstruction of the existing lines generally to suit the requirements of electric traction, it has been customary for the Health Committee to pave tramway streets from kerb to kerb at the same time as the tramways are being laid, and as the estimates for paving works to be executed by the Health Committee during the ensuing year are now being framed it is desirable that the Tramways Committee should at an early date decide which of the newly authorised lines are to be laid next year, so that the Health Committee may be enabled to include in their estimates the cost of the street works outside tramway limits, which will be a charge on paving capital account. The committee will no doubt desire that in addition to the Aigburth Road and Croxteth Road extensions, the Smithdown Road extension should be proceeded with at an early date, and these lines can be readily constructed without materially interfering with the existing lines of traffic. After a careful consideration of the streets of Liverpool and the lines of tramways generally, it appears to the city engineer that in the other districts of the city, at any rate, it will always be necessary to maintain certain of the main lines of traffic through the principal thoroughfares radiating from the business centre of the city to the outskirts. These trunk lines constitute a very large proportion of the total mileage of the existing tramways, and he is of opinion that the most convenient course to adopt would be to reconstruct these main lines in such an order as would effect the greatest saving in maintenance charges. The Tramways Committee should, if possible, now decide how much of the existing tramways are to be reconstructed for electric traction during the ensuing year, and the city engineer, after carefully considering the

condition of the existing lines, has come to the conclusion that the following are those which should first receive attention—West Derby route, from West Derby to Moss Street; Stanley Road route, from the city boundary to Commutation Row; Kensington route, from Old Swan to Moss Street; Walton route, from Spellow Lane to the Old Haymarket. It would probably be found convenient to continue the Smithdown Road route along Parliament Street to the Park Lane electric line, leaving the reconstruction of the existing lines in Grove Street, Oxford Street, and Mount Pleasant, until Parliamentary powers are obtained for the laying of a double line throughout this length. Mr. Brodie understands that probably 12 months will elapse before the new generating station to be erected in Pumpfields will be so far completed as to be able to supply electric power in sufficient quantities for working these lines by electricity, but it is pointed out that when these lines are reconstructed they will be available for horse traction in the same way as the Dingle route is worked at the present time, and, further, it would not be necessary to erect any poles or overhead work until the electrical power becomes available. In these recommendations the city engineer has assumed that the system to be adopted on the outlying lines will be the overhead electric trolley system, but should any other system be adopted he would still recommend dealing with the lines in the same order. The total length of new lines recommended to be constructed is as follows:—Aigburth Road extension 2¼ miles; Croxteth Road, ¾-mile; Smithdown Road, 5½ miles; total, 8½ miles. The total lengths of existing lines recommended to be reconstructed are as follows:—West Derby route, from West Derby to Moss Street, 5 miles; Stanley Road route, from the city boundary to Commutation Row, 4½ miles; Kensington route, from Old Swan to Moss Street, 4½ miles; Walton route, from Spellow Lane to the Old Haymarket, 4¼ miles; total, 18¼ miles. The estimated cost of the street works, exclusive of overhead or underground electrical equipment, will be:—New lines: Aigburth Road extension, £15,660; Croxteth Road, £5,220; Smithdown Road (including Parliament Street), £30,930; total, £51,810. Reconstruction: West Derby route, £25,000; Stanley Road route, £22,500; Kensington route, £22,500; Walton route, £21,250; total, £91,250.

The Tramways Committee announce that Councillor Rutherford will be appointed chairman during Mr. Wm. Oultoris's year of office as Lord Mayor. Since the Council adopted, experimentally, the overhead trolley system, great diversity of opinion has been locally expressed as to the wisdom of the decision, on various grounds, and "alarmists" are bringing forward their strongest arguments as to the dangers of overhead electric wires.

Manchester.—The City Council on Wednesday passed a series of resolutions which mark the first formal steps in the direction of acquiring the tramways and working them under the Corporation. The town clerk was authorised to serve notice upon the Manchester Carriage and Tramways Company, requiring them to sell to the Council certain portions of their undertaking, together with the plant. The Council have already practically decided to adopt the overhead wire system for working the cars.

Merthyr.—An exhaustive inquiry was held at Merthyr last week by Lord Jersey and Colonel Boughey, Light Railway Commissioners, respecting the light railway connecting Merthyr Dowlais and Cefn. The promoters are the British Electric Traction Company. After evidence for and against, Lord Jersey said it would appear that the local authorities and the general public considered these railways would be an advantage, and they would be prepared to recommend to the Board of Trade that an order be issued.

Middleton.—The Middleton light railway scheme, which has been approved by the Light Railway Commissioners, came before Sir Courtenay Boyle, at the Board of Trade on 20th inst., for confirmation. The scheme is promoted by the British Electric Traction Company, and is for the provision of a light railway or tramway through the districts of Rochdale, Castleton, Middleton, Chadderton, and thence into Oldham. The various Corporations interested were represented. The proceedings were private. The various clauses in the order were gone through, and arguments heard on disputed points. So far as the Oldham part of the scheme is concerned it is understood that as the result of the proceedings the promoters, who were represented by Mr. S. Morse, are to have the powers to make the line as proposed four hundred yards into Oldham, but the powers are not to be exercised for a period of two years, and the Corporation intend to go to Parliament for powers in the meantime to construct the line themselves.

Twickenham and Hounslow.—The proposal of the Drake & Gorham Electric Power and Traction Company, of which notice was given to the Twickenham District Council at their last meeting, is to run a light electric railway from the foot of Richmond Bridge, through the populous and new district of St. Margaret's, thence to Twickenham and through Whitton to a terminus near the main thoroughfare at Hounslow, a distance in all about six miles. It would connect two very populous centres, and afford a means of through, cheap, and speedy communication from Hounslow to Richmond. A large portion of the line, however, will pass through undeveloped, and open garden land, and it will run directly outside the gates of the large Government Military School of Music at Whitton, which may incur opposition on the part of the War Office, who are anxious for as much quietude as possible for the students. A part of the line is also within a short distance of the Government Observatory at Kew, and will be quite as near to the establishment as was the abandoned proposal for an electric railway line over Richmond Hill to Kingston, promoted by the West Metropolitan Tramway Company, and to which it was intimated objection would be raised on the ground that the electric currents might interfere with the working of the apparatus at the Observatory. As the Government intend extending the scope of the Observatory, it is quite feasible that any objections would be urged with double force. The construction of a line from Brentford through Isleworth and so on to Twickenham and Hampton Court, has been mooted, but a great portion of this line would run near the Observatory, although on the other hand, part of the new line from Kew to Hounslow is almost as contiguous to that establishment as the Richmond Hill route would have been.

Wallasey.—The question of the purchase by the Wallasey Urban District Council of the tramways of the district now owned by a private company was practically settled at the close of last week, when a meeting of ratepayers by a majority approved of the Council's suggestion to promote a Bill in the next session of Parliament. Electrical equipment is suggested. The cost of the tramways purchase is £102,000. In this connection the expenditure estimated by the Electrical Committee is £9,800, and the profit of the first year's working, it is stated, will be £304. A poll has been demanded and is to be taken for testing the views of the ratepayers at large.

TELEGRAPH AND TELEPHONE NOTES.

Cable Communication with Australia.—In the report of the accounts of the Eastern Extension Telegraph Company for the half-year ending June 30th, we find that the general reserve fund was debited with the cost of a partial renewal of the Java-Port Darwin "duplicate" cable. Last week we pointed out that some of the cables of this company might be interrupted without the public being made aware of the fact; we then referred to the solitary cable which runs between Banjoewangie and Singapore, the only alternative to which cable is afforded by the Dutch land-lines running through Java. From the above half-yearly report we see, however, that during the period of renewal of this "duplicate" cable between Banjoewangie and Port Darwin, communication with Australia must have depended entirely on the original cable laid between Port Darwin and Banjoewangie 27 years ago, that is, if we except the cable from Banjoewangie to Roebuck Bay, which Mr. J. Denison Pender has pointed out is dependent on the long coast land-line from Roebuck Bay to Adelaide, and which in a letter to the Chancellor of the Exchequer he describes as being "more or less unreliable."

Huddersfield Telephones.—The Postmaster-General has informed the Corporation that he will be prepared to grant that body a telephone license on the necessary powers being granted them by Parliament. A condition of the license is that it expires in 1911.

Manchester Telephones.—Yesterday a deputation from the Manchester Corporation was to interview the Postmaster-General in regard to the telephone question so far as concerns Manchester.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies—		
St. Lucia-St. Vincent ...	Sept. 24th, 1898 ...	...
Amazon Company's cable—		
Cable beyond Gurupa ...	June 8th, 1898 ...	...
Bolama-Bissao	June 21st, 1898 ...	...
Gibraltar-Tanger	Oct. 18th, 1898 ...	...
Saint Louis du Senegal-Fernando de Novonha ...	Oct. 17th, 1898. ...	...
Pernambuco-Ceara	Oct. 19th, 1898. ...	...
Landlines.		
Majunga-Tananarive ...	Oct. 24th, 1898. ...	Oct. 25th, 1898.
Maulmein-Bangkok... ...	Oct. 24th, 1898 ...	Oct. 25th, 1898.
Saigon-Bangkok	Oct. 20th, 1898 ...	Oct. 20th, 1898.

Chinese soldiers are reported to have cut the telegraph wire between Lukochiaou and Fungtai, near Pekin.

The Telephone Committee's Report.—The report of the Select Committee on Telephones has been issued as a Blue-book, together with proceedings of the Committee, the minutes of evidence, and an appendix. The report has already been fully dealt with in the Electrical Review. The minutes of evidence now published occupy no fewer than 476 pages.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barrow-in-Furness.—November 14th. The Corporation invite tenders for the supply and erection of cast-iron lamp columns, arc and incandescent lamps, automatic switches and fittings. Messrs. Kincaid, Waller & Manville, consulting engineers. See our "Official Notices" this week.

Bilston.—October 29th. Tenders are, according to an exchange, being invited for the construction of a line of telephonic communication between the Bilston waterworks pumping station at

the Bratch and the Town Hall at Bilston, with the necessary receiving and transmitting instruments, and also the setting up of electric recording apparatus in the reservoir at Goldthorn Hill, with communication wires from the recording apparatus to the pumping station at the Bratch, and also to the Town Hall, Bilston, for the Bilston Urban District Council. Plans and specification, may be seen at the offices of Mr. Baldwin Latham, M.I.C.E., engineer for the works, 13, Victoria Street, Westminster, S.W., and also at the office of Mr. John D. Wassell, clerk, Town Hall, Bilston, and the form of tender may be obtained on application to the Engineer or to the Clerk, on deposit of £5, which will be returned to all persons making a *bonâ fide* tender.

Edinburgh.—November 14th. The Council want tenders for the supply of marine boilers and mechanical stokers and engines and dynamos for the electric light station in McDonald Road. Consulting engineer, Prof. A. B. W. Kennedy, 17, Victoria Street, S.W., at whose office specifications and drawings may be seen. See our "Official Notices" this week.

France.—November 8th. Tenders are being invited until November 8th by the French Post and Telegraph Authorities in Paris for the supply of four lots of telephone cable, and until November 10th for 46 kilometres of gutta-percha insulated electric cable and 50 kilometres of paper insulated cable. Tenders are to be sent to Le Sous-secrétariat d'Etat des Postes et des Télégraphes, Rue de Grenelle, 103, Paris, whence particulars may be obtained.

Ghent.—October 29th. The Ghent Municipal Council is inviting tenders for the installation of the electric light at a new theatre. The work, says *Daily Tenders and Contracts*, has to be completed by June 1st, 1899 (a fine being imposed for every additional day to completion), and maintained for 12 months. Labour clause. The contract includes the supply and delivery of 1,337 incandescent lamps, 20 arc lamps, &c. All expenses for registering, stamps, notices, &c., which are estimated to cost 130 francs, to be paid by the contractor. A deposit of 8,000 francs is required, on which 2 per cent. will be paid after 60 days. Specifications seen with, and plans obtained, on payment of 40 francs, from M. Le Sécrétaire Communal (A. De Bruycker), Gand, or at the office of the paper mentioned above. Tenders, on stamped paper, registered, addressed as directed, with a certificate of deposit, to be posted by October 27th. The tenders will be opened at 11 a.m. on October 29th.

Great Yarmouth.—November 2nd. The Electric Lighting Committee is inviting tenders for the supply of coals to the electricity works for a period of 10 months from November 10th. Specifications at the office of the Borough Surveyor, Town Hall.

Hanley.—November 14th. The Corporation is inviting tenders for the erection of a refuse destructor. Particulars from Mr. J. Lobley, borough engineer.

Harrogate.—The Corporation wants tenders for the supply of 18 cast-iron arc lamp poles, 18 feet long above ground, fitted with Hyde Park carriers. Borough electrical engineer, Mr. Geo. Wilkinson. See our "Official Notices" October 21st for particulars.

Hornsey.—November 7th. The Urban District Council is inviting tenders for the supply and erection of electric lighting plant for its Central Public Library in Tottenham Lane, Hornsey. Particulars, &c., from the Council's engineer, Mr. E. J. Lovegrove. See our "Official Notices" this week.

India.—November 23rd. The East Indian Railway Company is desirous of introducing electrically-controlled block instruments on their system, and invites proposals from makers only for the supply of: For single line—18 instruments for nine blocks; for double line—80 instruments for 41 stations, and six spare instruments. Particulars from Mr. A. P. Dunstan, secretary, Nicholas Lane, London, E.C.

Manchester.—November 8th. The Corporation is inviting estimates for the laying of an extension of the system of underground telephone pipes, with other appurtenant works. For all particulars and drawings apply at the City Surveyor's Office, Town Hall, Manchester.

Middlesbrough.—November 29th. The Electric Lighting Committee is inviting tenders for the supply and erection of Lancashire boilers, and boiler house plant, slow speed steam dynamos and accessories, condensing plant and pipe work, overhead travelling crane, switchboard and instruments, accumulators, supply and laying of cables, meters. Specifications, &c., from the consulting engineer, Mr. Robert Hammond, 64, Victoria Street. See our "Official Notices" this week for further particulars.

Morecambe.—October 31st. The Electric Lighting Committee is inviting tenders for Lancashire boiler, continuous current steam dynamo (180 kw.), two 40-kw. transformers, switch panels, switches, &c. Electrical engineer, Mr. C. F. Parkinson. See our "Official Notices" October 21st for details.

Morley.—October 31st. The Morley Industrial Co-operative Society is inviting tenders for the wiring, &c., of its new buildings in Queen Street.

Redditch.—The Urban District Council is wanting proposals from firms of contractors who would undertake the wiring of consumers' premises on a hire purchase or deferred payment system. See our "Official Notices" this week for further particulars.

Southampton.—November 16th. The Committee of Visitors of the County Lunatic Asylum, Knowle, near Fareham, is inviting tenders for the supply of two engines and dynamos equal to an output of 24,000 watts each, together with all necessary washing machinery, lathe, drill, motors, lamp installations, &c., required in connection with the centralisation and increase of the light, heat, and power generating plant. See our "Official Notices" October 7th *re* specifications, plans, &c.

Spain.—November 8th. The Spanish Post and Telegraph Authorities in Madrid are inviting tenders until November 8th for the concession to establish and work a telephone exchange in the town of Cuenca. Particulars may be obtained from, and tenders to be sent to, La Direccion-General de Correos y Telegrafos, Madrid.

Tunbridge Wells.—October 27th. Tenders are being invited by the Corporation for the electric wiring and fitting of 10, Calverley Parade, for electric lighting, for the Corporation. Particulars at the Electrical Engineer's Office, Town Hall.

Toronto (Canada).—November 9th. The Toronto Board of Control is, according to *Daily Tenders and Contracts*, inviting tenders for a complete installation of electric lighting plant. Tenders will also be received for the various portions of the work, viz.: 1. Engine equipment. 2. Countershafts and pulleys. 3. Belting. 4. Boilers. 5. Feed pumps and condensers. 6. Water and steam piping. 7. Economisers. 8. Dynamos and station electrical apparatus. 9. Arc lamps. 10. Mast arms and lamp attachments. 11. Poles and overhead circuits. 12. Conduits and cables. Plans and specifications seen, and forms of tender obtained, at the office of the City Engineer, Toronto. The specifications for items Nos. 2, 3, 5, 6, and 7 may be withheld until the remainder of the apparatus is decided upon. A deposit in the form of a marked cheque, payable to the order of the City Treasurer, to the amount of 2½ per cent. of the value of the work tendered upon, must accompany each tender. Tenders, bearing the *bonâ fide* signatures of the contractor and his sureties, to the Chairman of the Board of Control, City Hall, Toronto, Canada, by noon on November 9th.

Wimbledon.—November 7th. The District Council is inviting tenders for the supply, delivery, and erection of transformers and accessories. Specifications, &c., from Mr. A. H. Preece, 39, Victoria Street, S.W. See our "Official Notices" October 14th.

Roumania.—November 8th. The General Direction of the Roumanian Posts and Telegraphs in Bucharest is inviting tenders until November 8th for the supply of 60 tons of galvanised steel wire, 2 mm. diameter, and 16,000 small porcelain insulators.

CLOSED.

Belfast.—The Corporation has accepted the tender of Messrs. Coates & Co. for the supply of an additional mechanical stoker.

Bexhill.—There was quite a large number of tenders submitted to the District Council for the various works connected with the electric lighting scheme, for which Mr. A. H. Preece is consulting engineer. From these there have been selected for acceptance that of Messrs. Hornsby, for the supply of water-tube boilers; that of Messrs. W. H. Allen & Co., for the engines and dynamos, &c.; that of the Chloride Electrical Storage Syndicate, for the supply of accumulators. The British Insulated Wire Company will supply the cables and arc lamps, &c., but the contract for the switchboards has not yet been given out.

Bolton.—The Corporation has just accepted the tenders for the supply of machinery and plant in connection with its electric trolley tramway scheme. It is stated that the scheme will cost £250,000. There will be 70 cars, 30 miles of single track, and a seven minutes' service. The contract for the supply of two continuous current generators, with Musgrave engines and boosters, has been given to Messrs. Mather & Platt, that for the cables has gone to the British Insulated Wire Company, while the British Thomson-Houston Company will supply the switchboards, &c.

Dewsbury.—The Corporation has accepted the tender of the Callender Cable Construction Company, Limited, London, at £1,306 10s. 1d., for the extension of the electrical cables to Oxford Road, James Street, and other streets in a residential portion of the town.

France.—The French Post and Telegraph Authorities in Paris have just divided a contract for 128 kilometres of paper insulated electric cables between Messrs. Aboilard & Co., of Paris, and the Société Alsacienne de Construction Mécanique, of Belfort.

Gloucester.—At the meeting of the Gloucester City Council on Tuesday the tenders were considered for the erection of electricity works for Gloucester, and that of Messrs. J. Gurney and Sons, of Gloucester, was accepted at £7,676. This was higher than the lowest tender by £376, but it was accepted because Messrs. Gurney guaranteed completion in nine months. The highest tender was £10,774. It is hoped to have the works running and the electric light installed by October next.

Plymouth.—We understand from an exchange that there were 16 tenders submitted to the Corporation for the supply of an enclosed (ironclad) continuous current motor, shunt-wound, for 10 B.H.P. at 850—950 revolutions, for 520-volt circuit, complete with spare armature, starting switches and resistances. They varied from £88 odd to £205, and the lowest was accepted, viz., that of the Newton Electrical Works, Limited.

Roumania.—Two tenders, both German, were submitted to the municipal authorities of Braila, Roumania, for the supply of electrical energy for lighting purposes in the town, the lowest being that of the Helios Company, of Ehrenfeld, Cologne, who quoted 69½ centimes per kilowatt-hour for private electric lighting and 34½ centimes for the public lighting.

FORTHCOMING EVENTS.

Friday, October 28th.—At 5 p.m. Physical Society, at the rooms of the Chemical Society, Burlington House. Agenda: (1) "An Influence Machine," by W. R. Pidgeon, M.A.; (2) "The Repetition of an Experiment on the Magneto-optic Phenomenon discovered by Righi," by Prof. Silvanus P. Thompson, F.R.S.; (3) "The Magnetic Fluxes in Meters and other Electrical Instruments," by Albert Campbell, B.A.

Tuesday, November 1st.—At 8 p.m. The Institution of Civil Engineers. Address by Mr. W. H. Preece, C.B., F.R.S., the president, and presentation of medals and prizes awarded by the council. Reception by the president in the library after the meeting.

Thursday, November 3rd.—At 8 p.m. Chemical Society. Papers to be read:—"A Determination of the Equivalent of Cyanogen," by George Dean, B.A.; "Note on the Action of Light on Platinum, Gold, and Silver Chlorides," by E. Sonstadt; "Methanetrisulphonic Acid," by E. H. Bagnall, B.Sc.; "A Composite Sodium Chlorate Crystal in which the Twin Law is not Followed," by W. J. Pope; "On the Composition of American Petroleum," by Sydney Young, D.Sc., F.R.S.; "On the Separation of Normal and Iso-heptane from American Petroleum," by F. E. Francis, B.Sc., Ph.D., and Sydney Young, D.Sc., F.R.S.; "On the Boiling Points and Specific Gravities of Mixtures of Benzene and Normal Hexane," by D. H. Jackson, M.A., and Sydney Young, D.Sc., F.R.S.: "On the Action of Fuming Nitric Acid on the Paraffins and other Hydro-carbons," by F. E. Francis, B.Sc., Ph.D., and Sydney Young, D.Sc., F.R.S.

Tuesday, November 8th.—Paper on "The Extraction of Nickel," by Prof. W. C. Roberts-Austen, C.B., F.R.S., Assoc. Inst.C.E.

Thursday, November 10th.—Institution of Electrical Engineers. Opening meeting for the session. Paper by Prof. S. P. Thompson on "Rotatory Transformers."

Wednesday, December 7th.—Institution of Electrical Engineers. Annual Dinner, Grand Hall, Hotel Cecil.

NOTES.

The Empire and Telegraph Cables.—In view of the tension at present existing between this country and France, we venture to repeat a warning which will now, perhaps, carry more weight than it did at the time it was written. The following is the extract referred to:—"We quite agree with the opinion expressed that the present cables which pass through the Mediterranean would probably be rendered useless in case of warlike complications, as this did actually happen during the Egyptian war; but we would go still further, and point out that the same objection applies with equal force to several sections along the proposed Cape route, which, in places, would necessarily have to lie in very shallow water, and where they could be easily cut by the enemy. Take, for example, the section which would pass off Brest, where, for more than 150 miles, all the existing lines to Africa and the East are in water of less depth than 100 fathoms; and through this dangerous belt it is now seriously proposed to lay a strategic cable! In the case of the Pacific scheme any such danger is quite avoided." That our views were well founded has been proved by the evidence given before the Departmental Committee which recently investigated the claims of the "all-British" cable *viâ* the Cape to Australia. One of the members of this Committee was Sir. J. C. Ardagh, Director of Military Intelligence, and in a report of the proceedings we read the following:—"Sir Daniel Cooper (New South Wales) and Mr. Playford (South Australia), but more especially the latter, were at first disposed to view their existing lines (two to Port Darwin, and one to Roebuck Bay) as quite sufficient for all purposes, though they would have liked another line added to this route. This satisfaction on their part with existing arrangements was, however, promptly dispelled by an intimation from Sir. J. C. Ardagh, representing the War Office, that in the event of our losing Egypt, or anything happening in that country adverse to our interests, the cables to Australia, India, and the East generally, would be cut at once." Bearing in mind the scheme of action of the French fleet recently outlined by Admiral Fournier, it is clear that the cables passing off Brest and those through the Mediterranean cannot be relied on in war time. It seems a great pity that an object lesson, such as the severance of our telegraph communication with the rest of the world would afford us, is necessary to convince Her Majesty's Government that the present system of cable connection with Australasia, India, and China is quite inadequate, and has absolutely no strategic value.

Magnetic Disturbances and the Loss of the "Mohegan."—With reference to the conjecture that the reason for the ss. *Mohegan* being so far out of her proper course was magnetic deflection of the compass, Prof. A. W. Rucker has written to the *Times*, showing the improbability of such a theory being correct, in the following words:—

As the suggestion that the wreck of the *Mohegan* may have been due to a local deviation of the compass is again referred to in a letter which appears in your columns to-day, you will perhaps allow me to point out that such deviations are more likely to occur on land, where the needle may be within a few feet of the disturbing cause, than at sea, where they must be separated by a greater or less depth of non-magnetic water. During the magnetic survey of the United Kingdom, carried out by Dr. Thorpe and myself, observations were made at 12 places in Cornwall. Of these Lizard Down, Porthallow, and Falmouth were the nearest to the scene of the disaster, and at all of them the deviation of the compass from the normal magnetic meridian was extremely small. The largest disturbance of this kind which was observed in Cornwall occurred at St. Levan, near the Land's End, and only amounted to 11 minutes of arc, or less than $\frac{2}{10}$ths of a degree. The largest disturbance of the dipping needle was at Mullion, and was only 14 minutes.

It is true that it is not impossible that the compass of a ship in relatively deep water might be appreciably affected for a distance of three or four miles by a concealed centre of magnetic disturbance. The best known case of this sort is that of Port Walcott, in North-West Australia, which was fully described by Captain Creak in the *Philosophical Transactions* for 1896. In that case, however, a compass in the neighbouring coast was affected, not as in Cornwall to the extent of a few minutes of arc, but through a range of 10°. To the improbability of such a source of danger as that suggested having escaped the notice of naval surveyors in a district so well known as the neighbourhood of the Manacles, we must, therefore, add the improbability of a great magnetic focus existing near land on which the magnetic disturbances are as small as they are in Cornwall. It is, of course, possible that here and there in that county there may be centres of magnetic disturbance greater than any we discovered; but from evidence collected in districts, such as the West of Scotland, where magnetic rocks abound, I have no hesitation in saying that in general such causes could not affect the compass of a ship at a distance of a couple of hundred yards, and that though cases, such as that above referred to, are known, to which this generalisation does not apply, their number is small.

Trades Unionism Rampant.—Messrs. Calvert have written again to the *Electrician* challenging the statements of Mr. Sims, the union secretary. In the first place Mr. Sims understated the rates paid by Messrs. Calvert by from 25 to nearly 50 per cent. Messrs. Calvert, moreover, did not discharge men who had joined the union. It appears that the bricklayers threatened to strike unless Messrs. Calvert's men became unionists, and these men were actually shut out of the building, and Messrs. Calvert tried to find the men other employment—a very different thing from what Mr. Sims stated. Naturally, Messrs. Calvert object to pay 40s. a week to a full blown painter to shellac a piece of casing that can as well be done by a boy at 6s. This appears to have been done, or attempted to be forced upon them, and they object to such tyranny. Why sober tradesmen should let themselves be terrorised over by the bricklaying fraternity it is difficult to say. It seems a pity that Mr. Sims could not make a clear statement of fact.

Electrically Operated Bridges.—On Wednesday morning the first of two new bridges, which are to be operated by electricity, and which are to cost about £30,000, was swung across the River Weaver, at Northwich.

Electric Light Interruptions.—On Thursday evening, the 20th inst., there was a failure in the Brighton Corporation electricity supply from 9.10 to 9.30 o'clock. The interruption was occasioned by a 220-kw. armature developing a sudden short circuit in its windings. The back rush of current into this was so sudden that the automatic cut-out had not time on its way out to entirely clear the contacts so as to prevent an enormous demand from the other dynamos. This large rush of current caused all of the other machines running at the time to drop their cut-outs, and so stopped the supply. As over 9,000 amperes were going out at the time, the extent of the disturbance to the private house districts must, obviously, have been very great. Fortunately, it being the early closing night, practically all the shops escaped inconvenience, and two of the theatres had intervals at the time. From the above it seems that the automatic minimum cut-out, as generally used in England, does not always afford the protection usually ascribed to its use.

About 7.30 p.m. on Saturday, shopkeepers' busiest time, there was a failure in the supply of electricity at Wolverhampton. The private consumers were without the light until 9.10 p.m., but it was 10.30 p.m. before the public thoroughfares were re-lit. The inconvenience caused seems to have been very considerable. The cause of the breakdown as given by Mr. Shawfield, the borough electrical engineer, is "the failure of two generator armatures at the main station." Our local correspondent says that this is the third or fourth time a breakdown of the kind has occurred, but happily there is not much chance of another similar collapse. The new scheme recently foreshadowed by the Lighting Committee of the Corporation, and detailed in the ELECTRICAL REVIEW of October 14th, was specially designed to obviate the risk of any such breakdown as this.

The Effect of the Drought on Steam Boilers.—In a letter to *Engineering*, Mr. C. E. Stromeyer, M.Inst.C.E., M.E., and N.A., chief engineer of the Manchester Steam Users' Association, says:—"A somewhat unforeseen result of the recent long spell of dry weather is the collapse of a relatively large number of boiler furnaces, and I write to warn steam users against this danger, and hope that the press, particularly in rural districts, will convey this warning to their readers. It appears that, as it is at present difficult to obtain sufficient water through the usual supplies, some boilers have now to be fed from old disused wells, or other questionable sources, which in this dry weather contain relatively much saline matter; in fact, nearly all fresh water supplies are now more saline than during a rainy season. As a consequence, more salt than usual enters a boiler, and as it is not distilled over with the steam, it accumulates until the water becomes overcharged, and salt scale is deposited on the furnaces, and these collapse. Through this cause this association has already suffered by having to renew three collapsed furnaces for some of its members, while about 20 other furnaces were on the point of collapsing, the water in these boilers being either quite or nearly saturated. In fact, in one case, although no collapse took place, the whole inside surface of the boiler was found covered with salt crystals about ½-inch cube. The water was, of course, quite saturated, viz., over 50 ozs. per gallon. I would, therefore, warn steam users to examine their boilers personally to see whether any salt has gathered around leaky seams, joints, or cracks, or whether the water in the boiler has a strong salty taste. If so, the boiler should at once be blowed down and refilled about 8 inches to 12 inches, a salinometer should be obtained, and care should be taken to keep the density of the water below $\frac{3}{32}$. Unlike marine boilers, land boilers are not fitted with salinometer cocks, and the water has therefore to be drawn from the water gauge. While doing so the top cock should be closed, otherwise a wrong sample is obtained."

Yorkshire College Engineering Society.—"Instances of the Right and the Wrong Way in Common Mechanical Details" was the subject of the opening address last Monday evening by the president of the Engineering Society in connection with the Yorkshire College, Mr. J. H. Wicksteed, C.E.

Personal.—We understand that Mr. Claude W. Hill has resigned the position of manager to the Phœnix Dynamo Company, of Bradford.

The Resistance of the Human Body.—Experiments to determine the resistance of the body to the passage of electric currents are described in a communication from Mr. James E. Boyd, of the Ohio State University, to the *Physical Review*, August, 1898. The experiments, says the *Electrical World*, were made with both direct and alternating currents, the circuit being from hand to hand, contact being made by immersing the four fingers of each hand in salammoniac solution. With alternating currents the resistance was obtained by measuring with a dynamometer the current flowing through a given resistance, and with the same voltage that flowing through the body. With E.M.Fs. varying from 4 to 6·8 volts, the resistance was found to be practically independent of the current flowing, averaging 1,550 ohms, the current varying from 2·6 to 4·4 milliamperes. With direct currents the resistance of the contacts was eliminated by using the fall of potential method, the measured currents being passed through the body and fall of potential between wrist and wrist, or any parts desired being measured by means of a condenser and galvanometer, the fall of potential without current being subtracted from that with current to eliminate any electrolytic effect. With about 1½ volts and 0·8 of 1 milliampere, the resistance from wrist to wrist was found to be about 625 ohms. From the liquid in the jar to the adjacent wrist a value of 350 ohms was found, giving a total resistance from jar to jar of about 1,325 ohms. Other resistances found were those from wrist to elbow, 200 ohms; from wrist to end of shoulder blade, 267, and from shoulder to instep, 291.

A New Property of Iron.—In a letter to *Nature* of October 20th, Mr. J. S. Stone, writing from Boston, U.S.A., describes an experiment which is at first sight startling. One end of an iron or steel bar is heated to redness and suddenly plunged into water. At the instant of plunging it the other end of the bar becomes heated. The action does not occur with brass. One is familiar with the sudden fall in the specific heat of iron when cooled to its critical temperature from a higher one, producing recalescence, but a similar property at ordinary temperatures produced by a sudden change in a distant part of the bar has never been noticed before, so far as we know. Mr. Stone discussed the phenomenon with several other scientific men, so that there can be no reason to doubt the accuracy of the observation. The physics of iron and steel is becoming a very large and important subject, and a discovery of this kind may lead to very important extensions.

A Conductor in a Hurry and a Sequel.—Our New York namesake quotes the following:—

The street car conductor was not in good humour. Someone has passed a bad quarter upon him, says the Detroit *Free Press*, and that accounted for his starting the car before the three women and a child were fairly aboard.

One of the women was mad at being dumped without warning into a seat; the conductor saw that as he started to collect their fare, but he was mad, too.

"Madam," he said, as she tendered her fare, "this child that is with you will have to be paid for as well."

"I haven't the slightest idea of paying its fare," snapped the woman.

"Then I shall put it off," answered the conductor, reaching for the bell.

"You don't dare," flashed the woman.

Ting! The conductor brought the car to a stop, picked up the child and deposited it upon the street, and rang to go ahead.

"Madam," he said grimly, "you will find your child back there on the corner."

"My child?" snapped the woman. "It isn't mine."

"Whose is it, then?" gasped the conductor.

"I haven't the slightest idea," she answered coolly.

Then the child's mother, who had been engaged in an exciting discussion with a friend over the merits of a new gown, awoke to the fact that her child was missing, and then the fireworks that played around the unfortunate conductor's head reminded him of a Fourth of July display.

The Mishaps on the Waterloo and City Railway.—*Daily Tenders and Contracts* yesterday gave its version of the "real cause" of the stoppages on this electric railway. It says that on one occasion the weight of the passengers, who crowded into the train like herrings in a barrel, brought the brake gear down on to the middle rail, thereby cutting off the current from the motors. As soon as the carriages were relieved of sufficient weight to clear the brake from contact the difficulty was overcome.

Shock Fatality.—The inquest was held last week into the death of the labourer who was killed by electric shock at Leven shipyard, Dumbarton, on 10th inst. The case has been already mentioned in the Electrical Review. The jury unanimously found that Connolly "was accidentally killed in consequence of his seizing hold of a wire charged with electricity while employed and at work in the Leven shipyard."

Coast Defence.—In preparation for eventualities with France, the military authorities at Portsmouth have asked the Corporation if the electric current used in lighting the town could be supplied for the searchlights erected on the sea front, and commanding the entrance to Spithead and the Solent. A ready affirmative has been given.

Main Box Explosion.—On Wednesday there was an explosion in an electric light main box in Wellington Street, Strand, W.C.

Lectures.—At the Floral Hall, Ashby-de-la-Zouch, on Saturday, Mr. L. W. de Grave, of Derby, lectured to a fairly large gathering of colliery officials and miners on "Recent Practice in the Design and Construction of Electric Mining Plant."

NEW COMPANIES REGISTERED.

Telephone Bell Push Syndicate, Limited (59,221).—This company was registered on October 20th, with a capital of £2,000 in £1 shares, to adopt an agreement with George L. Anders and Alexander J. Wilson, jun., and to acquire, own, and work an invention for "improvements in telephonic bell pushes." The subscribers (with five shares each) are:—A. J. Wilson, jun., 80, Lombard Street, E.C., gentleman; G. L. Anders, 33, Peak Hill Gardens, Sydenham, S.E., electrician; F. M. Robertson, 28, Darner Road, Fulham, S.W., gentleman; J. King, 14, Earlsfield Road, Wandsworth, S.W., gentleman; L. W. Stanley, 1 and 2, Great Winchester Street, E.C., gentleman; J. F. Jamieson, 35, Walbrook, E.C., accountant; F. O. Jerram, 40, Longley Road, Tooting, agent. The first directors (to number not less than two nor more than five) are to be nominated by the subscribers; qualification, £50. Registered office, 35, Walbrook, E.C.

National Conduit and Cable Company, Limited (59,251).—This company was registered on October 21st, with a capital of £1,000 in £1 shares, to construct, lay down, establish, fix and carry out any conduits, cables, wires, lines, accumulators and works, and to carry on the business of electric cable and wire manufacturers, electrical engineers and contractors, suppliers of electricity, &c. The subscribers (with one share each) are:—C. T. C. Price, 5, Prince Arthur Road, Hampstead, solicitor; H. G. Carvall, 52, Mortimer Road, Kingsland, N., clerk; N. G. Newington, 10, Croxted Road, West Dulwich, clerk; G. J. Jackson, 23, College Hill, E.C., secretary; C. W. Barrett, 98, Alderney Street, Warwick Square, S.W., clerk; J. H. B. Odell, 49, Fawcett Road, S.E., clerk; A. Benwell, 10, Machell Road, Nunhead, S.E., clerk. The number of directors is not to be less than three nor more than seven; the first are to be nominated by the subscribers; qualification, £100; remuneration as the company may decide. Registered office, 23, College Hill, E.C.

Electro-Smelting Company, Limited (59,252).—This company was registered on October 22nd, with a capital of £10,000 in £50 shares, to acquire any lands, mines, rights, minerals, &c., and to win, get, reduce, dress, refine, and prepare for market, ores and mineral substances, and precious stones. The subscribers (with one share each) are:—Arthur H. Brigg, Bradford, spinner; Leonard Calvert, Halifax, worsted spinner; John C. Horsfall, Crosshills, Keighley, worsted spinner; Benjamin Musgrave, Bradford, chartered accountant; Thomas Priestley, Great Horton, Bradford, manufacturer; Isaac Smith, 22, Heath View, Halifax, wool merchant; Francis Whitehead, Bradford, spinner. The number of directors is not to be less than three nor more than seven; the first are John C. Horsfall, Thomas Priestley, and Isaac Smith; qualification, £250; remuneration as fixed by the company. Registered office, 1, Bradford Exchange, Bradford.

General Water Power, Limited (59,259).—This company was registered on October 22nd, with a capital of £21,500 in £1 shares (1,500 deferred), to seek for and secure openings for the employment of capital in any part of the world, and to carry on the business of electricians and producers and generators of electricity by means of water power or otherwise. The subscribers (with one share each) are:—Percy H. Sainsbury, accountant, P. G. Tovey, clerk, Charles Boyle, clerk, and Herbert P. Cousins, registrar, of Worcester House, Walbrook, E.C.; C. F. A. Spashett, Hillfield Road, West Hampstead, registrar; J. H. McCashen, 30, Hamilton Road, Wimbledon, accountant; P. H. Hetherington, 14, Liston Road, Clapham, S.W. The first directors are Montagu F. Armstrong, John S. Bergheim, and the Hon. W. Vernon; qualification, 500 ordinary or 10 deferred shares; remuneration, £400 per annum and a share of the profits divisible. Registered office, 11, Cornhill, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Incandescent Electric Lamp Company, Limited (48,521).—This company's annual return was filed on October 11th, when 5,307 shares were taken up out of a capital of £10,000 in £1 shares. 2,000 are considered as paid, and £3,300 has been received on the others. No calls have been made on seven shares.

Sunbeam Lamp Company, Limited (25,498).—This company's annual return was filed on August 27th, when 1,765 shares were taken up out of a capital of £25,000 in £10 shares. 857 are considered as paid, and £9,030 has been paid on the others.

CITY NOTES.

Eastern Extension, Australasia, and China Telegraph Company, Limited.

The fiftieth half-yearly ordinary general meeting of the above company was held on Wednesday at Winchester House, the Marquis of Tweeddale presiding.

The Chairman said that before he asked them to approve of the motion that the report and accounts of the directors now submitted be received and adopted, he would trouble them with a few observations on the proceedings of the half-year which ended in June. The gross revenue for the half-year was £277,382, being a decrease of £13,467. He thought that would not be regarded as unsatisfactory when it was borne in mind that the past half-year compared with the period when the China, Japan, and other tariffs were considerably higher than they were now, and that the political disturbances and the cutting of the cable between Hong Kong and Manila affected their traffic with these islands. From those causes a larger decrease might have been anticipated; but, happily, the growth of traffic in other directions had very nearly made up the deficiency. The working and other expenses amounted to £102,873, being a small increase of £3,448, which was accounted for by the fact that the repairs to cables during the half-year under notice were heavier than in the same period in 1897, and also by the opening of several stations in the Philippine Islands by arrangement with the Spanish Government, to which he referred at some length at their last meeting. The usual interim dividends at the rate of 5 per cent. per annum had been paid, amounting to £62,500, and they had transferred to the general reserve fund the sum of £50,000, while the sum of £10,723 was carried forward to the next account. During the half-year the policy of strengthening weak portions of their lines had been steadily pursued, with the result that the Penang-Sumatra cable had been entirely renewed. The Java-Port Darwin duplicate cable has been renewed to the extent of 135 nautical miles, and 207 nautical miles had been added to the Hong Kong-Cape Bolinao cable to Manila. The cost of those operations had been £46,709, the whole of which, as they no doubt had observed from the accounts, had been debited to the general reserve fund. When he last had the pleasure of addressing them he referred to the dangers and privations to which their staff was exposed in the Philippine Islands, owing in the first instance to the native rebellion, and afterwards to the hostilities which broke out between Spain and the United States. The latter event rendered the position of their staff, as they could easily imagine, a very delicate one, and that state of things lasted several months, but he was happy to say, that although great privations were suffered by their employés, and great damage was done to property both public and private, no lives were lost, nor did he think any of the staff were injured. When the peace preliminaries were agreed upon, they were able to make several satisfactory arrangements with the two Governments, under which the Hong Kong-Manila cable and the Manila-Panay cable were reopened on a neutral basis, so that the company was now working direct with the public instead of through the medium, as before, of the Spanish offices at Manila. Unfortunately, the political situation was still very disturbed, and further fighting was reported to have occurred a few days ago in the neighbourhood of their Tuburan station on the island of Cebu. He should mention that the courage and devotion to duty displayed by the company's staff during the earlier troubles had been specially recognised by the Spanish Government, who had granted special decorations to the officers concerned. He could not himself personally refrain from expressing his admiration of the conduct of Mr. Herbert Jones, their superintendent, and his subordinate during the extremely trying time they had passed. The time, he hoped, would come when they would be able to recognise from that side of the table the services they had rendered during that time. The company's claim against the Government of the United States for compensation in respect of the loss from the cutting of the Manila cable had not yet been decided. The Government appeared to be under the impression that the repair of

the cable was effected by their own officials, but that was not the case, as the repairs were temporarily made by the company's staff, assisted by an American boat, and were afterwards permanently effected by the company's own boat. He had on more than one occasion referred to the establishment of cable communication in the Pacific, and the occupation of the Philippines by the United States was undoubtedly a real stimulus to efforts having that object in view. So far, however, as they knew, nothing definite had yet been arranged, and all he could say with regard to it was, that they were carefully watching developments in that direction, and the shareholders could rely upon them to take steps to protect in every way the company's interests.

Mr. F. A Bevan seconded the motion, which was agreed to.

Mr. Newton proposed a vote of thanks to the chairman and the board, and this having been carried, the meeting ended.

North Staffordshire Tramways Company, Limited.

The general meeting of this company was held last week at the Guildhall Tavern, Gresham Street. Mr. Alderman E. J. Hammersley presided.

With regard to the negotiations with the British Electric Traction Company, the Chairman said that he had been in hopes of announcing the final settlement of all matters, and within the last half hour, indeed, they had received information which induced them to anticipate that the purchase of their undertaking would be completed within a few days on the terms already agreed to. A further meeting of the shareholders would then be held, at which exact figures and all the details would be laid before them, and within a short time afterwards they would receive the amount for which they had agreed to sell their undertaking. He understood that a new company had been registered, which would amalgamate the powers possessed by the old North Staffordshire Tramways Company, as well as the powers which had been obtained for the extension through the Potteries, and there would be one great system of light railways and tramways throughout that populous district. It would be under one management, and he hoped that it would be as successful as that of the North Staffordshire Tramways Company had been. The traffic receipts for the half-year to June 30th last, as compared with those for the corresponding period of 1897, showed a decrease of £218, but they had been engaged in the reconstruction of the whole of the lines for the purpose of substituting electric traction for steam, and they had, therefore, had many difficulties to contend against. They had carried fewer passengers by 43,000, although the number conveyed had been nearly 2,000,000. The traffic had been carried on under considerable disadvantages, and it had required the greatest vigilance, day and night, to conduct the traffic, and to prevent accidents. It would not have done to stop the traffic, as this would have entailed not merely temporary, but permanent loss. He hoped that in two or three weeks the reconstruction of their lines would be finished, and then they would be able to submit to the shareholders a full statement of everything they had done in connection with the work.

The Morecambe Electric Light and Power Company.

The shareholders in this company, now in liquidation, have received a statement of accounts, which will be submitted at a general meeting on November 2nd. From this statement it appears that the total receipts since the extraordinary meeting in February, 1896, amount to £3,423 5s. 7d., the principal items including the following:—From Morecambe District Council for plant and undertaking (less the amount awarded under arbitration), £2,718; other plant sold, £131 12s. 5d.; cash at bank, £500; other receipts (including acceptances matured, bank interest, &c.), £73 13s. 2d. The expenditure included the following:—Messrs. Johnson & Tilly, solicitors, taxed costs, £382; liquidator's solicitor's costs, £188 10s. 1d.; debenture bonds, "A" series, in full, £2,052 6s. 7d.; debenture bonds, "B" series, at 3s. 5½d. in the £, £530 12s. 5d.; other expenses (including law costs, secretary's salary, rent, rates and taxes, wages, Board of Trade fees, bank commission, half costs of award), £268 18s. 9d., leaving a balance of 17s. 9d. The statement further shows that there are no assets available for either unsecured creditors or ordinary shareholders, as follows:—Various unsecured creditors, £324 13s. 4d.; ordinary shares, £6,759.

Brazilian Submarine Telegraph Company.

The ordinary general meeting of this company was held on Wednesday at Winchester House, Mr. John Denison Pender presiding.

The Chairman, in moving the adoption of the report, said there was a decrease in the total expenditure for the half-year of £4,690 odd, which, however, was entirely a question of repairs or no repairs of cables. In the previous half-year there was a sum of £5,725 standing to repairs of cables, and in the half-year ending with June last the company were fortunate in having no such expense. After providing £3,200 for debenture interest and sinking fund, and £1,713 for income-tax, there remained a balance on the half-year's business of £77,300 odd. The repair of one of the cables would be rather an expensive matter, lying, as it did, at a depth of considerably over 2,000 fathoms. The present statement dealt with the Brazilian accounts, but next half-year there would be taken into consideration also the receipts of the Western Brazilian, in conformity with the arrangements that had been carried out. With regard to what had taken place since the last meeting, which was held in August, to confirm the carrying out of the arrangements entered into with the Western Company, that company's shareholders had sent in their assent to a very much larger amount than was required for the legal majority for the carrying through of these arrangements by the two boards. The result was that there now sat on the board of the Brazilian Submarine Company Mr. W. S. Andrews, Lord Richard H. Browne, Mr. John Coppen, and Mr. D. H. Goodsall as directors from the Western Company. Personally he (Mr. Pender) was occupying the chair there for the last time. The board considered, and very rightly, that the seniority as a telegraph director of Mr. Andrews, who had been for many years associated with the telegraph world, entitled him to take the chair on the joint board; and he (Mr. Pender) hardly needed to say that he most thoroughly concurred with the rest of the directors in the appointment.

The motion for the adoption of the report was carried unanimously, and the proceedings closed with the usual compliment to the chairman and directors.

Wireless Telegraph and Signal Company, Limited.

An extraordinary general meeting was held on Tuesday at the offices of the company, Mark Lane, Mr. H. Davis presiding.

The resolutions which were passed at the meeting on the 7th inst. were confirmed. They were (1) for increasing the capital of the company to £200,000 by the creation of 100,000 further shares of £1 each, 25,000 of the new shares to be offered at par in the first instance to all who are members of the company at the date of the offer; and (2) for substituting for article 55 an article providing that every member shall have one vote for every share held by him, "but no member shall be entitled to vote in respect of any shares held by him in excess of two-fifths of the issued capital for the time being of the company."

The Chairman, in answer to questions, stated that it was only intended at present to issue 25,000 of the new shares at par, and these would be offered to members who were on the register on 15th prox. Any shareholder who had odd numbers of shares must buy or sell some shares, as the directors had been advised that they could not issue fractions of shares.

The City of London Electric Lighting Company, Limited.—Return of gross revenue from supply of electricity only during quarter ended September 30th, 1898:—Gross revenue from public lighting, quarter ended September 30th, 1898, under new scale, £3,196; corresponding quarter last year, under old scale, £3,146. Gross revenue from private lighting, &c., less allowances to customers, quarter ended September 30th, under new scale, £23,705; corresponding quarter last year, under old scale, £21,978; total, quarter ended September 30th, under new scale, 1898, £26,901; total, corresponding quarter last year, under old scale, £25,124; increase, £1,777. Equivalent of 8-C.P. lamps connected on September 28th, 1898, 334,573; increase during quarter, 12,874. Equivalent of 8-C.P. lamps connected on September 29th, 1897, 278,162; increase during corresponding quarter last year, 7,264.

Oriental Telephone and Electric Company, Limited.—The directors have declared an interim dividend of 4d. per share, free of income-tax, payable to those shareholders whose names were on the register on 26th inst. The warrants will be posted 31st inst.

Callender's Cable and Construction Company.—The board have declared an interim dividend of 5s. per share on the ordinary shares, being at the rate of 10 per cent. per annum.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending October 22nd, 1898, were £242 14s. 10d.; aggregate to date, £12,681 4s. 7d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending October 21st, 1898, were £2,566 2s. 6d.; corresponding period, 1897, £2,613 5s. 9d.; decrease, £47 3s. 3d.

The City and South London Railway Company.—The receipts for the week ending October 23rd, 1898, were £1,024; week ending October 24th, 1897, £970; increase, £54; total receipts for half-year, 1898, £16,277; corresponding period, 1897, £15,521; increase, £756.

The Dover Corporation Electric Tramways.—The receipts for the week ending October 22nd, 1898, were £184 0s. 2d.; week ending October 23rd, 1897, £122 5s. 10d.; increase, £61 14s. 4d.; total receipts to October 22nd, 1898, £6,984 9s. 8d.

The Dublin United Tramways Company.—The receipts for the week ending October 21st, 1898, were as follows:—D. U. T. Co., horse cars, £2,282 0s. 8d.; ditto, electric cars, £319 9s. 4d.; D. S. D. Co., electric cars, £647 15s. 9d.; total, £3,249 5s. 9d; corresponding week last year—D. U. T. Co., horse cars, £2,795 19s. 8d.; D. S. D. Co., electric cars, £493 6s. 7d.; total, £3,289 6s. 3d.; decrease, £40 0s. 6d.; aggregate to date, £68,994 12s. 6d.; aggregate to date last year, £63,575 2s. 7d.; increase to date, £5,419 9s. 11d.; Worked:—The mileage open is 13 miles electrically, 81 miles by horses, as against 8 miles electrically, and 34 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending October 23rd, 1898, amounted to £1,376; corresponding week last year, £1,335; increase, £41.

The South Staffordshire Tramways Company.—The receipts for the week ending October 21st, 1898, were £638 10s. 8d.; week ending October 22nd, 1897, £664 8s.; aggregate receipts for 42 weeks, £26,559 13s.; last year, £26,148 8s.

The Western and Brazilian Telegraph Company, Limited.—The receipts for the week ending October 21st, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,404.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, Oct. 19th.	Closing Quotation, Oct. 26th.	Business done during week ended Oct. 26th. 1898. Highest.	Lowest.
137,400£	African Direct Telegraph, 4 % Debs.	100	4 %	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	6 — 7	6 — 7	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	92 — 95	92 — 95	...	...
923,960£	Anglo-American Telegraph	Stock	£2 9s	£2 13s	3 %	63 — 66 xd	61 — 64	...	...
3,038,020£	Do. do. 6 % Pref.	Stock	£4 18s	£5 6s	6 %	113½—114½	111 —112	114¼	111
3,038,020£	Do. do. Deferred	Stock	...	...	...	15½— 15⅝	13⅞— 14⅛	14 1/16	13¾
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	7 %	15¾— 16¼	15¾— 16¼	16 1/16	...
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	...	...	111 —115	111 —115	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	4 %	2¾— 3¼	2¾— 3¼	...	...
10,000,000$	Commercial Cable	$100	7 %	8 %	8 %	180 —190	180 —190	...	...
918,297£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105¼	...
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½ %	2 %	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Telegraph	10	8 %	8 %	7 %	8½— 9½	8½— 9½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	15½— 16½	15½— 16½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs., Nos. 1 to 6,000	50	4½ %	4½ %	4½ %	103 —106%	104 —107%	...	...
60,710£	Direct United States Cable	20	2¼ %	2½ %	...	11½— 12 xd	11½— 11⅝	11 11/16	11⅜
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101—104	...	...
400,000	Eastern Telegraph, Nos. 1 to 400,000	10	6½ %	6½ %	7 %	17¾— 18 xd	17¾— 17¾	17⅞	17⅝
1,295,000	Do. 3½% Pref. Stock	100	...	...	...	104 —107 xd	104 —107	106	104½
40,000	Do. Prov. Certs., 50 % paid	...	...	...	...	52 — 55 xd	52 — 55	...	...
89,900	Do. 5 % Debs., repayable August, 1899	100	5 %	5 %	5 %	100 —103	100 —103	...	...
1,302,615£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	126 —130	126 —130	126½	...
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	17½— 18 xd	17½— 17¾	17¾	17½
25,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	5 %	100 —104	100 —104	...	...
100,500£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	5 %	101 —104	101 —104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	125 —129	125 —129	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	100 —104	100 —104	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	101 —104	101 —104	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	102 —105	102 —105	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	4 %	...	104 —107%	104 —107%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	4½ %	12 — 12½	12 — 12½	12⅛	12⅛
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	16¾— 17¼	16¾— 17¼	17⅛	16¾
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	10 %	10 %	28½— 29½	28½— 29½	29¼	29⅛
160,000£	Do. do. do. do. 5 % Debs.	100	5 %	5 %	5 %	101 —104	100 —103	...	...
97,000	Halifax & Bermuda Cable, 4½% 1st. Mt. Dbs., w'n. 1-1,200, rd.	100	...	...	...	101 —104	101 —104	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	52 —55	52 — 55	54¼	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	6 %	109 —112	109 —112	...	...
28,000	Montevideo Telephone, 6 % Pref., Nos. 1 to 28,000	5	4 %	4 %	4 %	2¼— 2¾	2¼— 2¾	...	...
484,597	National Telephone, 1 to 484,597	5	5⅛ %	5⅛ %	6 %	5½— 5⅝	5⅜— 5⅝	5½	5⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	13½	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5½— 5⅝	5⅜— 5⅝	5½	5⅛
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —105	100—105	101½	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝— ¾	⅝— ¾	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	5 %	8 — 9	7½— 8½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	133 —138 xd	133 —138	...	...
58,000	United River Plate Telephone	5	4 %	5 %	6 %	4½— 4¾	4½— 4¾	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	...	...	103 —106	103 —106	...	...
15,609	West African Telegraph, 7,501 to 23,109	10	4 %	nil	nil	3½— 4½	3½— 4½	...	...
213,400£	Do. do. 5 % Debs.	100	5 %	5 %	5 %	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ¾	¼— ¾	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	104 —107	104 —107	...	...
64,269	Western and Brazilian Telegraph	15	3 %	2 %	3½ %	12¼— 12¾	12¼— 12¾	...	...
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	8 — 8½	8 — 8½	...	...
33,129	Do. do. do. Def. Ord.	7½	1 %	nil	⅛ %	4 — 4½	4 — 4½	4	...
389,521	Do. do. do. 4 % Deb. Stock Red.	Stock	...	...	...	107 —110	107 —110	107	...
88,321	West India and Panama Telegraph	10	⅞ %	1 %	⅞ %	1 — 1¼	1⅛— 1⅜	1 5/16	1⅛
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	9¼— 9⅝	9¼— 9⅝	9⅝	9¼
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	7 — 9	7 — 9	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	106 —109	106 —109	...	...
1,163,000$	Western Union of U.S. Telegraph, 7 % 1st Mort. Bonds	$1000	7 %	7 %	7 %	105 —110	105 —110	...	...
160,100£	Do. do. do. 6 % Ster. Bonds	100	6 %	6 %	6 %	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	5 %	6 %	7 %	11½— 12½	11½— 12½	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	6 3/16	...
26,000	*Chelsea Electricity Supply, Ord., Nos. 1 to 10,277	5	5 %	5 %	6 %	8½— 9½	8 — 9	8⅜	8⅛
60,000	Do. do. do. 4½ % Deb. Stock Red.	Stock	4½ %	4½ %	4½ %	113 —115	113 —115	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000	10	5 %	7 %	10 %	23 — 24	23 — 24	23½	22⅛
10,000	Do. Ord. Nos. 90,001 to 100,000	10	...	...	...	22½— 23½	22½— 23½	22¾	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16 — 17	15½— 16½	16½	15⅞
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	127 —132	127 — 132	131	130½
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	nil	nil	nil	12½— 13½	12½— 13½	...	...
10,000	Do. do. do. Nos. 30,001 to 40,000 £8 paid.	10	...	...	...	10 — 11	10 — 11	10 9/16	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14½— 15½	14½— 15½	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	...	5 %	5 — 5⅛	5 — 5⅛	5 3/16	5⅛
10,000	House-to-House Electric Light Supply, Ord., 101 to 10,100	5	...	...	4 %	9 — 10	8½— 9½	9¼	...
10,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	9½— 10½	9½— 10½	...	...
62,400	*Metropolitan Electric Supply, 101 to 62,500	10	4 %	5 %	6 %	15 — 16	15 — 16	16	15⅝
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	4½ %	117 —121	117 —121	...	...
6,452	Notting Hill Electric Lighting	10	2 %	4 %	6 %	15½— 16½	15 — 16	15 1/16	15⅛
31,980	*St. James's and Pall Mall Electric Light, Ord.	5	7½ %	10½ %	14½ %	16½— 17½	15½— 16½	16	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
50,000	Do. do. 4 % Deb. Stock Red.	Stock	...	...	4 %	104 —107	104 —107	...	...
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	2⅞— 3⅛	2⅞— 3⅛	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	7 %	9 %	12 %	14½— 15½	14½— 15½	15¼	14¾

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation Oct. 19th.	Closing Quotation Oct. 26th.	Business done during week ended Oct. 26th, 1898. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	...	...	...	3 — 3½	2⅞— 3⅛	2⅞	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	94 —100 xd	94 —100	...	...
30,000	British Electric Traction	10	...	...	...	16⅜— 17¼	16 — 17	17 1/16	16⅝
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13 — 14	13 — 14	13⅝	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	2½%	*nil*	*nil*	1⅜— 2	1⅝— 1⅞	1⅞	1⅝
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	*nil*	4 %	2¼— 2½	2 — 2¼	2¼	2
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	109 —113	109 —113	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	104⅜	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	...	...	...	10 — 11	10 — 11	10⅜	10 1/16
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	110—113	110 —113	...	...
19,894	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	9⅞— 10¼	10⅜	10
129,179	Do. do. do. £6 paid	10	...	...	...	6 — 6½	5¾— 6¼	...	...
59,254	Do. do. Pref. half-shares £1 paid ...	...	...	...	...	1¼— 1⅝	1¼— 1⅝	...	...
67,680	Do. do. Def. do. £5 paid ...	...	...	...	...	4½— 5	4½— 5	...	...
630,000*l*	City and South London Railway	Stock	1⅛%	1⅛%	1⅛%	70 — 72	70 — 72	72	70½
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £3 pd.	10	...	...	...	2¾— 3¼	2¾— 3¼	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	1½— 2	1½— 2	1½	...
82,850	Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	90 — 95	91 — 96	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5 %	5½%	6 %	2½— 2⅝	2½— 2⅝	2⅛	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5 %	5½%	6 %	4 — 5	4 — 5	...	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	101 —103	101 —103	...	...
110,000	Electric Construction, 1 to 110,000	2	5 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2⅛	...
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ...	2	7 %	7 %	7 %	2¾— 3¼	2¾— 3¼	...	...
111,100	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	105 —107	105 —107	106½	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅜— ⅝	⅜— ⅝	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	¼— ½	¼— ½	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	10½%	7 %	7 %	10 — 12	10 — 12	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	8 %	10 %	12 %	20½— 21½	20½— 21½	21⅛	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18 — 19	18 — 19	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	4½%	110 —115	110 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	22½— 23½	22 — 23	22	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞%	2⅞%	3¼%	10⅜— 10½	10 7/16— 10 9/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15½— 16	15½— 16	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	39 — 43	37 — 41	40	39
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	100 —103	104 —107	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	...	113 —118	106 —111	115⅝	107⅜

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10⅛.
British Aluminium, Ordinary, 10—11; 7 % Pref., 12—13.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13—14; 1st Preference Cumulative 6%, £5 (fully paid), 7⅞—8¼. Debentures, 107—110. Dividend, 1897, on Ordinary Shares 10%.
London Electric Supply Corporation, £5 Ordinary, 3½—4.
National Electric Free Wiring, 10s. paid, ⅜—½.
*T. Parker, £10 (fully paid), 14—15.
Yorkshire House-to-House Electricity, £5 Ordinary Shares fully paid, 8—8½. Dividend for 1896—6%.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (October 13th, 1898).

MARKET QUOTATIONS, Wednesday, October 26th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a ,, Nitric .. .. .. per cwt.	29/-	29/-	..
a ,, Oxalic .. .. .. per cwt.	32/-	32/-	..
a ,, Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per ton	37/-	37/-	..
a Ammonia, Muriate (grey) .. per ton	£19	£19	..
a ,, ,, (white) .. per ton	£26	£26	..
a Bleaching powder .. .. per ton	£6 15	£6 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£14 10s.	£14 10s.	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a ,, (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£18	£18	..
a Lead, Nitrate .. .. .. per ton	£23 10s.	£23 10s.	..
a ,, White Sugar .. .. per ton	£30 10s.	£30 10s.	..
a ,, Peroxide .. .. .. per ton	£27 10s.	£27 10s.	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3¾d.	3¾d.	..
a ,, Caustic (75/80 %) .. per ton	£24	£24	..
a ,, Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. .. per cwt.	64/-	64/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 10	£6 10	..
a ,, Recovered .. .. per ton	£5 10	£5 10	..
a ,, Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£8 15	£8 15	..
a ,, Crystals .. .. .. per ton	£3	£3	..
a ,, Bichromate, casks .. per lb.	3d.	3d.	..

METALS, &c.	This week.	Last week.	Increase or Decrease.
b Aluminium Wire, in ton lots .. per ton	£294	£294	..
b ,, Sheet, in ton lots.. per ton	£191	£191	..
c Brass (rolled metal 2" to 12") basis per lb.	6¼d.	6¼d.	..
c ,, Tube (brazed) .. .. per lb.	8¼d.	8¼d.	..
c ,, Wire, basis .. .. per lb.	6¼d.	6¼d.	..
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f ,, Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£64	£63 10	10s. inc.
g ,, Wire (basis price) .. per lb.	7¾d.	7¾d.	..
g ,, Sheet .. .. .. per ton	£64	£63 10	10s. inc.
g ,, Rod .. .. .. per ton	£64	£63 10	10s. inc.
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	5/6	5/6	..
h India-rubber, Para fine .. per lb.	3/10½ forw'd	3/9½ forw'rd	1d. inc.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i ,, Pig (Cleveland warrants) per ton	45/10	45/3	7d. inc.
i ,, Forgings, according to size per ton	From £11	From £11	..
i ,, Scrap, heavy .. .. per ton	45/-	45/-	..
i ,, Wire galvanised No. 8 .. per ton	£8 15	£8 15	..
g Lead, English Ingot .. .. per ton	£13 5	£13 5	..
g ,, ,, Sheet .. .. per ton	£14 2 6	£14 2 6	..
l Mica (uncut slabs 8" long) .. per lb.	5/6	5/6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. .. per bottle	£7 4	£7 4	..
o Platinum .. .. per oz.	£2 16	£2 16	..
i Steel, Magnet, according to description .. .. .. per ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£83 to £84	£84 15	decrease
g ,, foil .. .. per lb.	1/3	1/3	..
n ,, wire Nos. 1 to 16 .. .. per lb.	..	1/4	..
j Yarns, Cotton, Single 10lb. bundles per lb.	6¾d.	6¾d.	..
j ,, Flax, 6 or 8 les... .. per lb.	3¾d.	3¾d.	..
j ,, Hemp, 2 ply 10 lbs. .. per lb.	3¾d.	3¾d.	..
j ,, ,, Russian, 10 lbs. per lb.	4¼d.	4¼d.	..
j ,, Jute, 180 lbs. rove .. per ton	£11 10	£11 10	..
j ,, Manila, 24 thread .. per ton	£30	£31	£1 dec.
k Zinc, Sheet (Vielle Montagne bnd.) p. t.	£28	£27	£1 inc.

a Quotations supplied by Messrs. G. Boor & Co.
b ,, ,, ,, The British Aluminium Co., Ltd
c ,, ,, ,, Messrs. Thos. Bolton & Sons.
d ,, ,, ,,
e ,, ,, ,,
f ,, ,, ,, The India-Rubber, G.-P., and Teleg. Works Co Ltd
g ,, ,, ,, Messrs. James & Shakspeare.
h ,, ,, ,, Jackson & Till.
i Quotations supplied by Messrs. Bolling & Lowe.
j ,, ,, ,, Henry C. Yeo & Co.
k ,, ,, ,, Morris Ashby, Limited.
l ,, ,, ,, Sanders, Wake & Co.
m ,, ,, ,, W. T. Glover & Co., Ltd.
n ,, ,, ,, P. Ormiston & Sons.
o ,, ,, ,, Johnson Matthey & Co.

ELECTRICAL LEGISLATION IN LONDON DURING 1898.

It may be interesting to place on record a complete list of the results of various Bills affecting the County of London, and which were considered in the legislative session of 1898. The statement on this subject, which is extracted from a report of the Parliamentary Committee of the London County Council, is given below. It is to be noted that in those cases where the words "petition presented" appear, this refers to the action of the County Council, whilst the other comments made also reflect the views of the Council's Parliamentary Committee.

Electric Railways and Tramways.

Charing Cross, Euston, and Hampstead.	Petition presented and satisfactory amendments settled by arrangement. Bill passed.
City and Brixton ...	Satisfactory amendments settled and Bill passed.
City and South London	No amendment necessary. Bill passed.
Foreign Cattle Market, Deptford.	Satisfactory amendments inserted after negotiation. Bill passed.
Finchley-Hendon Light Railways.	Council opposed the application for the order, and was represented at the local inquiry. Application rejected by Light Railway Commissioners.
Great Northern and City	Petition presented. Amendments arranged, but Bill subsequently withdrawn.
London, Walthamstow and Epping Forest.	No action necessary. Bill passed.
London, Walthamstow and Epping Forest.	No action necessary. Bill withdrawn.
Metropolitan	Petitions presented. Some amendments obtained. Bill passed.
New Cross and Waterloo	No action necessary. Bill not proceeded with.
Paddington and Charing Cross.	No action necessary. Bill not proceeded with.
Highgate and Finchley Tramways.	Provisional order refused.
London United Tramways.	Petition presented, and appeared upon before Select Committee in House of Commons. Amendments inserted to protect the position of the Council under the company's existing Acts and Orders. Bill passed.
Woolwich and South-East London.	Consent refused to tramway provisional orders.

Electric Lighting.

Central Electric Supply Company.	Petition presented. Bill rejected by Select Committee.
Chelsea Electricity Supply.	Petition presented. Bill passed.
General Power Distributing Company.	Bill watched. Bill suspended until next session.
Metropolitan Electric Supply.	Petition presented to both Houses. Bill passed.
Bermondsey Electric Lighting (Vestry).	Communications were addressed to the Board of Trade as to amendments necessary. Amendments obtained, but order included in Electric Lighting Orders Confirmation (No. 12) Bill, which did not pass.
Holborn and St. Giles Electric Lighting (Company).	Communications were addressed to the Board of Trade as to amendments necessary. Amendments obtained and order confirmed. (Included in Electric Lighting Orders Confirmation (No. 13) Act, 1898.)
Holborn District Electric Lighting (Company).	Communications addressed to the Board of Trade as to amendments necessary. Orders amended, amalgamated, and confirmed. (Included in Electric Lighting Orders Confirmation (No. 13) Act, 1898.)
St. Giles' District Electric Lighting (Company).	
Marylebone Electric Lighting (Vestry).	Communication addressed to Board of Trade as to amendments necessary. Order amended but confirmation refused by Parliament. (Included in Electric Lighting Orders Confirmation (No. 12) Bill, which did not pass).
Marylebone Electric Lighting (Company).	Not proceeded with by Board of Trade.
St. Marylebone Electric Lighting (Company).	Do. do.
Bethnal Green, Poplar and Whitechapel Electric Lighting (Company).	Do. do.
Bermondsey, Rotherhithe, Greenwich, &c., Electric Lighting (Company).	Do. do.
Lewisham Electric Lighting (Company).	Do. do.
Lewisham District Electric Lighting (District Board).	Do. do.

THE BOSTON STREET RAILWAY CONVENTION.

We had almost thought that the four-wheeled electrical car was defunct in America, but Mr. McCulloch's paper at the above convention, on the earnings and economy of the single and double truck car, disposes of the error. The single truck admits of a wheel base of 7 feet, and, it might be added, allows the car to behave like a boat at sea, for the car body is usually 20 feet long and has end platforms of 4 feet, so that there is an overhang at each end of over 10 feet. Hence the double truck car with the motors geared to one axle only, and so utilising half the load only for adhesion. The question resolves into the relative merits of long and short cars. For the long car it may be claimed that the passenger capacity is doubled for the same number of conductors, and the capacity of a line is doubled for the same headway. It is assumed that the larger car is a better vehicle to ride upon, but unless the line is fully worked there will be longer waits. For short journeys it is noted that a passenger will take the first car which offers; for long journeys he will wait a bit for the more comfortable car, even at busy hours, morning and night. Obviously, therefore, for journeys of some distance, headway is not so very important a factor, and cars may be less frequent and longer. To get over the busy hours trailer cars are usually added, but they have their defects in not being automobile, with all that this entails, and they increase the number of doors to be under the conductor's eye, while an additional conductor means loss of some of the economy hoped for. Our author's comparison is made between short cars of 20 feet body and the long cars 26 feet, seating respectively 28 and 36 passengers, which seems too small a difference to the English mind accustomed to seeing double truck cars much more longer than single truck cars. The American single truck car is probably longer also than the English single truck car.

During heavy travel the short cars are assumed to have trailers, bringing up the total capacity to 35 seats. The motors are W.P. 50. The double truck motors are assumed G.E. 800, and the trucks of maximum traction type; the load being chiefly on the motor driven wheels which are made larger than the other pair. The conclusion drawn is that the single car is more suited to dense frequent traffic with many stops, the long car for long distance, and for pleasure travel with high speed and few stops. The cost of repair and maintenance for each class comes out equal per passenger for both trucks and motors. Generally, the conclusion is favourable to the double truck car, if only that the change from one to the other seems to be always followed by increased travel—a proof of the public preference for long cars. For power driven cars, the English public, with numerous steam cars, has become accustomed to long cars, and, we think, any electrical line will make a mistake if it does not at the very first adopt the long car.

In Milwaukee the street cars weigh 35,000 lbs. and have four motors.

In another paper stress is laid upon the importance of the motive power being ample, and the importance of light weight and slow peripheral speeds of armatures.

Whatever may have been the case at the outset, we do not find Americans committing the mistake made on the City and Waterloo line which is very much underpowered. The cars are said to have been sent from America very much too heavy, at least, much heavier than expected. Why was expectation not in parallel with facts? The great mistake of all motor-car people, be it in road or rail vehicles, lies in starting off with the idea that a horse can only exert 1 horse-power, whereas he can exert really about two-thirds of a H.P. for eight hours daily and several horse-power, or, at least, a heavy traction, for a short time. A motor capable of beating a horse over a period of eight hours is not in it with a horse for starting effort. Hence the large power of motors, which have again been enlarged for continuous speeds, which are now rapidly approaching railway speeds, and fast leading up to an experience which can be readily made available on steam lines. It is advised to sand track by means of a special car, avoiding sand boxes on passenger cars. Possibly this is good practice, as someone would be responsible for proper sanding, and accidents might perhaps be avoided. One speaker referring to carbon brushes states that by removing them every six days and treating in oil their life was increased from six to 40 or 60 days. Sandpapering should be discriminately and sparingly employed. A special testing department is advocated both for electrical work and general supplies. The general conclusion to be drawn is, that the electrical railway industry occupies a leading place among American industries. Distances there are great and the country is poorly supplied with the means of transportation and has few good roads. There is thus an immense field for electrical lines, and there is every appearance that electrical lines will increase rapidly—indeed, they may become almost the only new construction gradually ousting the steam railroads or checking their hitherto rapid development, and some day, perhaps, transforming them to their own system.

MOTOR VEHICLES.

We need not here discuss the question of the rivalry between the different types of motor vehicles. Electricity will daily find a wider field. We may, however, take the general question of the sanitary aspect of motor vehicles as put forward by Mr. Shrapnell Smith in his recent paper at Birmingham. The greatest argument of all in

favour of self-propelled vehicles need scarcely be dwelt upon. We refer to the horse question. Both in the general pollution of the streets, and the existence of innumerable stables, the public is only too well aware of the intensity of the nuisance arising from animal haulage. Granting that even 90 per cent. of the filth made, and the dust from pavements pounded to destruction by hoof action, is at once removed or washed away, the remaining 10 per cent. in a city, only one-tenth as big as London, must be serious and disease-provoking. Apart from the filth aspect the destructive action of horses iron-shod hoofs is a patent source of expense. Mr. Smith makes a comparison between the cost of refuse removal by horse carts and motor carts, and shows a saving for London of 45, and for a provincial town of 31 per cent.

As regards road damage it is assumed that hoof action is responsible for two-thirds, and we think this is more than a fair estimate. As regards congestion of traffic, it cannot be for a moment disputed that the abolition of the horse will reduce the total length of vehicles very considerably. Mr. Smith estimates the reduction at one-half. A horse is really a very long animal, and with its projecting pole and space behind probably does about double the length of an average vehicle.

Motor vehicles will aid communication in the country where it would not pay to run a tramway. As we have long since pointed out, the time may come when many country roads will be wired for the trolley system and free vehicles, *i.e.*, not on rails, will be able to draw off current.

At present the self-contained motor vehicle alone meets the case of the poorer districts. A motor vehicle need not be of any serious danger. It is very easy to make them so that they will not move unless the driver is in his place, that they will stop automatically should the driver rise from his seat, be thrown off, or even faint and fall over. The general discussion was in favour of motor cars, and Mr. Smith made a good point in asking any cyclists present if they chose the wheel tracks or the hoof tracks on a road on which to cycle. This was probably conclusive as to the relative damage of hoofs and wheels. One speaker also alluded to the economy of the power to use local stone for road repairs in place of granite. All who have driven much in the country know how very much more pleasant to drive upon is a road without granite. But we all know that the granite resists the hoof action better, though it leaves the road surface full of projecting little knobs in a way which is not the case with local stone other than granite. Motor vehicles are certainly improving. We saw two last week in Coventry which ran freely up the very steep hill from the north to the centre of the town, and we were at once struck with the idea that the designer must have given a good deal more than the nominal horse-power for such a vehicle. Apparently of about two-horse type, they had probably several horse-power of motors.

AN AMERICAN VIEW OF GERMAN COMPETITION.

Writing to *Modern Machinery*, Mr. Heaton, the superintendent of the Loomis & Hart Manufacturing Company, considers that in America a great deal too much is made of Germany and her technical schools. He considers that Germany was obliged to have technical schools, because she had no large and well-equipped factories in which to teach apprentices.

He describes a recent editorial in the journal as tending to make believe that Germany was the very centre of progress and prosperity, freedom and advancement, and to contradict this, he cites a few figures. In England the income-tax limit is $800 per annum. In Prussia, the most fortunate of the German States, it is as low as $225, and apparently everyone but paupers must pay income-tax in Germany. But what, he asks, are the facts. Only 8 per cent. of the people are above the low limit of $225 annually. No less than 92 per cent. of Prussia's 32 million people have to live on incomes of less than 62 cents (2s. 7d.) per day, and how much less can hardly be guessed, if we remember how many in England get less than the English limit of $800. Yet a generation ago things were not so bad, and this, says Mr. Heaton, is the price Germany is paying for the privilege of competing with and underselling England, whose markets are unprotected. If Germany was compelled to pay wages equal to England and America, her foreign trade would stop. Wages are about one-half the English rate, and one-third the American rate, whereas in England money will buy more than in either Germany or America. It is to our knowledge quite a delusion that people can go to Germany and live more cheaply than in England, and this is the case generally on the Continent. Of course, by living like a native one can live cheaply, but one can live cheaply in England by living as an agricultural labourer, and the cheap living argument is worthless.

Hours of labour, again, are 12 to 14 daily, against 9 and 10 in England and America, and discontent is rife. The gist of Mr. Heaton's remarks are, in fact, to the effect that Germany is competing at the cost of her life's blood, and that either the strain cannot last, or it will be reduced by amelioration of the workers' conditions, and a stop will be put to the competition with civilised countries like England and America, to which title Germany can scarcely pretend to aspire under her present conditions, political and social.

There may, of course, be a substratum of truth in all this, but it by no means follows that the ability of a whole family to live for a small sum per week is necessarily indicative of privation. In England we spend, as a nation, a large annual sum per family, but food is a small item. The chief expense of a family is in such items as rent and other things quite apart from food, and the average British workman puts aside very little out of his $10 to $15 per week for his family. A full half to his own greedy self, and a poor half to the family of six is common enough. Again, even if the Germans are killing themselves to compete, the competition is real, and requires a good deal of consideration on our part.

If the competition was fair it would be less objectionable, but all Continental competition with England seems to have a back set of enmity, to wit, France and her sugar bounties, which we are fools to allow for a single day. For years France has been in open warfare against England; yet England buys the bulk of French exports. The same with Germany. We buy millions annually from Germany, and are only disliked for our ability to do so.

One hears very little grumbling at the keenness of American competition, even though America deals very unfairly by us in return for the free entry of her goods to England, but America's tariffs are placed rather in economic ignorance than from enmity.

THE APPLICATION OF ALTERNATING CURRENTS TO ELECTRIC TRACTION.*

The hold which direct current now has on the operation of street railway cars is such that it would be rather difficult in future to displace the direct current motor from the car itself. But even now the alternating current is being called in at the transmission end of the electric traction problem, its domain ending at the sub-feeders, where rotary transformers convert the alternating current to direct. Looking at the larger problems in electric railroading which involve the changing of present steam roads into electric, much seems to be left to engage the attention of electrical engineers as to the best methods of tackling them. In recent numbers of the *Engineering Magazine*, Messrs. Davis and Forbes carry out in a most extended manner the equipping of an electric road between New York and Philadelphia, one aspect of which they treated some time ago, and on which we made comment at the time. In the present instance the same authors first discuss in a general way the question of transmitting electric power from a waterfall or other "cheap sources" to a steam railroad by means of the alternating current, and the operation of such a road by electric motors. The conclusion which they reach as to the application of the alternating current directly on the cars is, we must confess, hardly encouraging. They assert, in effect, that the alternating motor, as constructed to-day, is not adapted to direct operation of railroad trains, either on the axles of the cars or at the head of the trains as a locomotive; first, on account of the difficulties in starting under load; and, secondly, owing to the difficulty of controlling the necessary variations in speed. On the other hand, they consider that the alternating current can be better applied indirectly to railway operation, because of the facility with which it can be transmitted at high potential over long distances. It is a special case of the latter arrangement which the authors then fully discuss, and which is, specifically, the problem of a new road built for very high speed, with trains at frequent intervals, and comparing the relative first cost and operating expenses, assuming electric power to be obtained (*a*) from a cheap source at a distance, with the corresponding charges, and (*b*) assuming the usual power stations located at intervals along the road. The authors take the oft-discussed case of a road between New York and Philadelphia, assuming several cases, among them two sources of power, each 100 miles from the line of the railway. They assume three-phase alternating current transmission at 20,000 volts, with 1,000 volts direct current from sub-stations to railway motors, with 30 sub-station rotary transformers. They also assume the road to have three tracks, trains of five cars each, with a three-minute headway, with trains 8½ miles apart, thus showing very high speed. Each train is not to require more than 10,000 H.P. at the station under economical conditions. The cost of such an equipment is compared against that of 11 power stations distributed along the line, 8½ miles apart, including one at each end of the line, each supplying current at three sub-stations, with rotary transformers, with power stations to generate alternating current at 10,000 volts three-phase to sub-stations, where it is con-

* New York *Electrical Engineer*.

verted to 1,000 volts direct current to the railway motors. The other conditions being the same, it is assumed that the development of the water-powers is to cost no more than the 11 power stations, which, in the authors' opinion, is highly unlikely, favouring the water-power transmitted as against the steam-power stations distributed along the line. In general, the authors state that every care has been taken to be fair to the distant source of power, and where there was any room for doubt, the "cheap source" has been given the benefit.

It would take us too far to go into the details of the calculations, which are highly interesting; but the final conclusions reached are that the items added to the cost per car mile by the use of water-powers located 100 miles away about balance the greater cost of fuel, water, oil, waste, repairs to power stations, and power station wages. While, as stated, we cannot go into the minutiæ of the calculations, it may be interesting to note that the proposed transmission line is figured at $25,310,000, the copper alone amounting to $9,780,000.

According to the authors, the case discussed by them shows conclusively that it would not pay to utilise the water-power. Against the objection to the assertion that this covers only one problem, they insist that the one chosen enables us to arrive at a general conclusion, since we are dealing with a very large amount of power at a comparatively short distance.

Granting that the calculations of the authors are fairly correct, and they have applied checks to them, we are bound to confess that we are not greatly surprised at the results. If 50,000 volts had been used instead of 20,000, as assumed, the cost of the copper would have been reduced to $1,555,000, a saving of $8,225,000, while if 100,000 volts had been used the copper would only have cost $390,000. But even that, according to the authors, would not have saved the day. This interesting calculation is well worth the study of all interested in this class of work. It must not be forgotten, however, that the distance of transmission assumed by the authors is 100 miles, and to that extent, of course, it is a special case. A shorter distance would make a material difference in the results, and we might suggest, as an addendum to their present calculations, one which should have for its object the determination of the distance at which transmitted cheap power can compete with power distributed along the road. It would also add much to the value of the solution of the problem here involved if the authors had considered the case where the energy is produced at the mouth of the coal mine instead of by water-power. We might then have a direct comparison as between steam stations distributed along the road and a single concentrated steam plant. Besides, the latter condition of a coal mine available within a reasonable distance, and even alongside the track of a railroad is a case of frequent occurrence.

ELECTRICAL ALARUMS.

By J. EBEL.

Considering the large variety of electrical apparatus designed for commercial or domestic purposes, one is impelled to the conclusion that there is hardly any article of such wide-spread and universal adoption as the electric trembling bell, but, notwithstanding the enormous output of this particular article, its form and device has apparently, with a very few exceptions, undergone no material alteration from the original type.

Since the introduction of the dry battery, which has now reached a condition bordering upon perfection, a little more progress has been made with regard to the compactness, utility, and convenience of a suitable combination of the alarum and battery. A general description of some improvements in this direction may afford considerable matter of interest to many of your readers.

Fig. 1 represents a standard pattern of electro-magnet with armature hammer and break contact bracket. There is nothing particularly new in this combination, its novelty and merit resting solely upon the compactness and simplicity of its general arrangement, thus facilitating the rapidity and cheapness of manufacture. The electro-magnet is secured to a board by means of a screw and washer, two little projections being pressed into the wood render it firmly

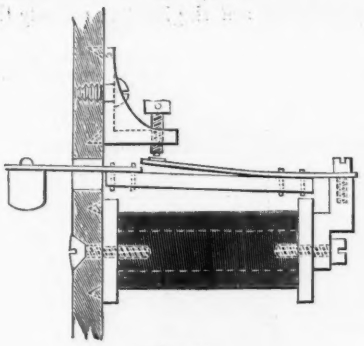


Fig. 1.

secure. The hammer and contact spring are riveted to the armature and secured to the electro-magnet by means of a brass bracket and two screws.

The contact bracket, which is fitted with an adjustable contact screw, is secured to the woodwork as shown. This combination is condensed to the extent that it can be conveniently encompassed in the small space of 1 × 2·5 inches.

Fig. 2 is a section of a double alarum and battery combined, which consists of a portable case of dimension 6 × 6 × 3 inches, containing two Siemens dry cells, type O, sufficient space being allowed between these to accomodate

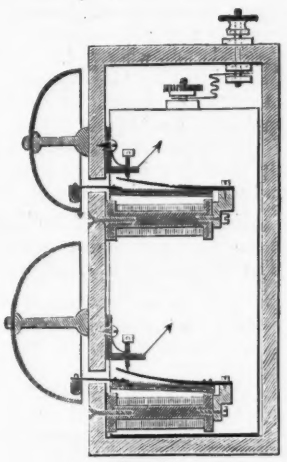


Fig. 2.

two electro-magnets, whose hammers reach through suitable openings in the case placed in such a position that it enables them to strike the bells which are upon its exterior. The two bells differ from one another, both in size and pitch, which, since they are intended to work independently from the same battery, is necessary to form a marked distinction between them. It will also be evident that it can be arranged to work a single alarum.

Fig. 3 is a sectional view of another type of alarum known as the "Rattler." The principal feature attending this class lies in the fact that it is dust-proof and watertight. This device, with the exception that the bell is entirely dispensed with and a diaphragm substituted, is similar to the arrangement shown in fig. 2; the electro-magnet hammer assumes a vertical position, and by its action strikes the diaphragm, which is so situated that the opening in the side of the case is completely covered by it on the interior, while the exterior side of the opening is covered by a sounding board which has a small hole in the centre of it, the action of the hammer upon the diaphragm produces a strong vibration and a rattling noise from which the name of the apparatus is derived. From this description it will be observed that the case is securely closed in upon all sides.

Fig. 4 is a diagram of a burglar alarum. The usual principle of those in general use consists of completing the circuit by means of opening or closing doors or windows to which contacts are fitted, and then connected up to the ordinary pushes, the bell ringing immediately the circuit is

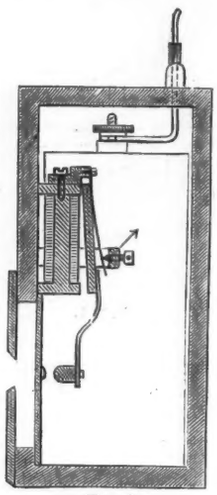


Fig. 3.

completed. The principle demonstrated by the accompanying diagram is, however, the reverse to the one described, inasmuch that the alarum comes into operation immediately upon the circuit being broken; by this means a decided advantage is gained, because the slightest defect in the line through tampering, or any other reason, would at once be made known by the alarum, whereas in the former instance similar defects would render the apparatus useless for its designed purpose, and, moreover, its defects could not be discovered without some trouble and testing.

The form of this apparatus resembles that of fig. 1 or fig. 2; the only exception being, that the electro-magnet solenoid is wound with two wires, one of a somewhat large dimension and having a resistance of 10^{ω}, and the other of a smaller dimension giving a higher resistance of approximately 190. The adjacent ends at one extremity of these

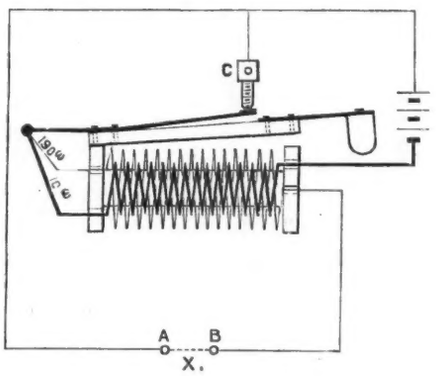
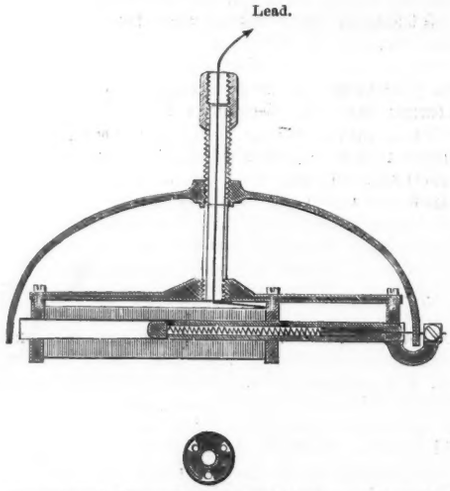


Fig. 4.

two coils are joined together and permanently connected to the armature hammer or contact hammer, the other two ends by making an intermediate connection with the contact screw, C, are connected to the poles of the battery in such a manner that the current passing through the two coils, would for each coil produce the same polarities on the extremities of the electro-magnet. The position, X, is the operating part in the out-going circuit, which operative effect can be arranged in numerous ways, *i.e.*, by an opening contact spring attached to a flexible twin wire which is squeezed into the slot of the door, window, or sash, this insertion falling out of its position when the door is opened, at once breaks the circuit and gives the desired result; again, the circuit between the points A B may be closed with a very fine wire, almost invisible to the naked eye, and placed in any position where it is most likely to be broken, this affords a simple and expeditious method of obtaining the effect required, and which is explained as follows:—

When the apparatus is adjusted for action the battery current passes through the two wire coils and forms a circuit. The electro-magnet with its highest resistance, which in this instance is 200^{ω} becomes sufficiently excited to cause a slight descent of the armature from the contact screw, E, and thereby causes it to permanently maintain this pendulous position. The line being broken at X would cause the fine wire coil to be thrown out of the circuit, whereupon the circuit being now open, the armature would return to the contact stud, E, and thereby establish the make and break alarum circuit having only the thick wire coil retained.

Fig. 5 shows an entirely new form of electric alarum for very large sizes. Whereas the ordinary alarums working upon the "make and break" system are only satisfactory up to a limited size (say, 6 inches diameter of bell), it is also



Top View enlarged of Brass Tube. Wrought-iron core with steel balls.

Fig. 5.

obvious that the larger the alarum the greater must be the vibratory amplitude of the hammer taps, and the intervals of proportionately longer duration, which result is practically unattainable by the present system, although it could be partly approached through the application of a larger electro-magnet. This method, however, necessitates a larger battery power, and consequently produces the great disadvantage of excessive sparking at the points of contact, thus bringing about a rapid destruction of those parts, and furthermore, the make and break system cannot be worked either in series or in parallel, since each bell, for perfect working, requires its own circuit.

The section, fig. 5, shows a solenoid wound round a brass tube, which contains an automatic, adjustable, hollow iron core. This core is provided with three longitudinal grooves for the accommodation of small steel balls, thus affording a practically frictionless longitudinal movement, the interior of the core contains a helical spring of suitable tension, having one of its extremities secured to the core, and the other attached to a fixed point situated as shown. The entire combination of parts are secured to a substantial bracket by means of screws, and by a piece of gas tube of suitable dimensions is suspended within the interior of a large gong or dome which forms a cover to the whole arrangement. The circuit is governed by an ordinary solid contact button or switch. When the circuit is open, the core, which answers the purpose of a hammer, assumes its normal position as shown, but immediately upon closing the circuit, the core is drawn rapidly to the left and makes impact with that portion of the gong, and immediately upon breaking the circuit, the recoil of the spring compels the core to produce another blow upon the opposite portion of the gong, *i.e.*, to the right, thus it will be seen, that action and reaction produces alternate blows, the rapidity of which

may be varied "*ad lib.*" according to the size of the gong. To especially adapt this gong for *continuous ringing*, I have conceived a device consisting of a combination of gear wheels, and an escapement wheel in conjunction with a spiral spring and winding key. The contact is produced by a star wheel, the points of which form a rubbing contact with an insulated spring strip. For exceptional large currents carbon contacts may be used with advantage.

The simplicity and compactness of this alarum renders it peculiarly adaptable for cheapness of manufacture. Its great reliability of action being largely due to the rubbing contacts being made at the *sending* station only, also another advantage is that any number of gongs may be worked in any circuit, whether they are in series or parallel. This apparatus is especially adapted to do duty for time bells in large factories, mines, &c., where a number of them could be worked from the time keeper's office.

BREAKS IN SUBMARINE CABLES.

In the *Electrician* of September 23rd, Mr. W. J. Murphy gives certain rules "to calculate rapidly or to estimate mentally, the influence of the E.C. upon results obtained by Schaefer's method of localising breaks in submarine cables." The correction for the effect of the E.C. on the measured resistance is given by Mr. Schaefer as

$$\mp \left\{ K_1 \left(\frac{e}{c} - \frac{e}{n\,c} \right) - \frac{e}{c} \right\}.$$

(See *Electrician*, October 15th, 1897, p. 813.)

Mr. Murphy points out that "writing this $\frac{e}{c}(K_1 - \frac{K_1}{n} - 1)$, or, say, $\frac{e}{c}$ N, where $N = (K_1 - \frac{K_1}{n} - 1)$, it is clear that the coefficient of $\frac{e}{c}$ depends only on the value of n, the ratio of the two testing currents, since

$$K_1 = \frac{\sqrt[1\cdot8]{n}}{\sqrt[1\cdot8]{n} - 1}.$$

It is more *convenient*, however, to base the correction on $\frac{e}{n\,c}$; that is, upon the quotient of the larger of the currents into the voltage of the E.C., in which case M (the coefficient of $\frac{e}{n\,c}$) $= \{K_1 n - (K_1 + n)\}$.

Values for both N and M are given in parallel columns for various battery ratios n recommended in practice, and reference to these two columns, as given below, will explain why the M formula is preferred to the N formula, "since it is *easy to remember* that M = 0·400 when $n = 1{\cdot}8$, and that there is an increase of 0·009 nearly in M for every increase of a tenth in n."

n.	N.	M.
1·8	0·222	0·400
1·9	0·215	0·409
2·0	0·210	0·420
2·1	0·204	0·429
2·2	0·199	0·438
2·3	0·195	0·447
2·4	0·190	0·456
2·5	0·186	0·465
2·6	0·182	0·474
2·7	0·178	0·481
2·8	0·175	0·490
2·9	0·172	0·499
3·0	0·169	0·506
Mean difference = 0·1	0·0044	0·0088

A sufficiently correct rule for the E.C. correction is:

1. Divide the earth potential difference (in millivolts) by the stronger testing current flowing through the cable (in milliamperes), and multiply by 0·4 if the current ratio n is nearly 2; or by 0·5 if nearly 3; and by the mean 0·45 if n is about 2·5.

Mr. Murphy adds another rule by which to remember whether the correction is a plus or a minus quantity.

2. The correction is *subtractive* when the direction of the E.C. is such as would be produced by a *minus* (Zn) battery pole applied at the testing station and *vice versâ*; it being practically an invariable rule that the negative battery pole is to line during tests made by the method.

A further *rough* rule instead of (1) is also given, viz, when the bridge ratio arms are equal and the milliammeter is placed in the battery circuit (that is, when the current through the milliammeter equals 2 c), the E.C. correction may be obtained, when n is about 3, by simply dividing the E.M.F. of the E.C. by the larger of the milliammeter readings taken when balance is obtained, because it is only when the E.C. is abnormally strong, or the testing currents relatively weak, that any serious discrepancy will obtain.

Examples.—Taking E.C. = 500 millivolts (half volt), and $n\,c$ as 50 milliamperes, and selecting 2 as the value of n, in order to make the discrepancy of the *rough rule* as large as it is ever likely to be in practice, gives the following comparative values for the E.C. correction:

By correct coefficient $\frac{500}{50} \times 0{\cdot}420 = 4{\cdot}2$ ohms, error *nil*.

By rule 1 $\frac{500}{50} \times 0{\cdot}400 = 4{\cdot}0$ „ „ 0·2 ohm.

By *rough* rule $\frac{500}{100} = 5{\cdot}0$ „ „ 0·8 „

"The largest error is in this case unimportant. It is possible, however, for the correction and consequently the error to be ten times as large as the above, so that the rougher rule should not be used blindly."

There is no doubt that Mr. Schaefer's formula for the distance of a break is further simplified, and working out consequently facilitated by writing the E.C. correction portion $\mp \frac{e}{c}$ M, as suggested by Mr. Murphy, and giving the value of M for all likely battery ratios in tabular form, with Mr. Schaefer's values for K_1.

The only exception which we take applies rather to Mr. Schaefer's formula, as explained in our criticism of the test—see the Electrical Review, December 31st, 1897, p. 919.

We then pointed out that while Mr. Schaefer claims to have disproved the strict accuracy of Kennelly's law of *inverse square roots* for the variation in resistance of an exposed area under different current strengths, and in his own formula substitutes for it the 1·8 root instead of the square root, his results for the distance of a break are generally less exact than those given by Kennelly's "two-current polarisation zero" test. So far, therefore, from proving the inaccuracy of Kennelly's law, results appear rather to establish it. Moreover, the value of x, calculated by Mr. Schaefer's formula are often found to be more exact *without* the E.C. correction which Mr. Murphy has somewhat simplified. We further pointed out in this connection that Mr. Schaefer measures his E.C. *before* applying the testing current, and that this is unsound in principle, since the polarisation component of the E.C. will vary greatly under two testing currents of different strength, and at the moment of taking off the testing current may even be reversed in direction to what it was *before* testing.

Institution of Electrical Engineers.—The opening meeting of the session will be held on Thursday, November 10th, when a paper will be read by Prof. Silvanus P. Thompson on "Rotatory Transformers." We learn that the annual dinner will take place in the Grand Hall of the Hotel Cecil on Wednesday, December 7th, and that the invitations are likely to be issued during the coming week.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1898.

Compiled expressly for this journal by W. P. Thompson & Co, Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

21,248. "Improvements in and connected with the electro-deposition of metals." S. O. Cowper-Coles. Dated October 10th.

21,261. "Improvements in electrical ignition apparatus for internal combustion engines." T. Wardell. Dated October 10th.

21,265. "Improvements in certain drums for holding electric cables." T. Oxley. Dated October 10th. (*Complete*)

21,359. "Improvements in and connected with shades or reflectors for electric lamps." S. L. Kilpin. Dated October 11th.

21,374. "Improvements in rheostats or electric heaters." E. O. Rastrr. Dated October 11th. (*Complete.*)

21,394 "Improved press for moulding electrotype matrices." G. E. B. Eyre, W. H. Spottiswoode, C. A. Spottiswoode, and E. J. Passingham. Dated October 11th.

21,401. "Improvements in step by step dial telegraphs with duplicate indicators to record the indications given and received in signalling." R. R. Harper. Dated October 11th.

21,407. "Improvements in dynamo-electric machines." A. F. Berry. Dated October 11th.

21,410. "Improvements in controlling switches and apparatus for electric motors." R. Hutchison. Dated October 11th. (*Complete*)

21,467. "An improved form of alternating current transformer or economy coil." Veritys, Limited, and L. J. Steele. Dated October 12th.

21,480. "Improvements in or relating to channels, tubes, and wells, for underground electric conductors and the like." C. A. W. Huttman. Dated October 12th.

21,492. "Apparatus for generating and utilising electric energy." W. S. Simpson. Dated October 12th.

21,501. "Improvements in coin-freed electrical apparatus." W. L. Wise. (E. G. Lochmann & Cie., Germany.) Dated October 12th.

21,505. "Improved device for use in connection with apparatus for the electric haulage of vehicles." F. Roberts. Dated October 13th.

21,524. "Improvements in electro-magnetic variable speed and clutch gearing." H. A. Wollaston (of Pope & Son), and R. Kennedy. Dated October 13th.

21,550. "Improvements in systems of control for electric motors and railway trains." W. B. Potter. Dated October 13th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, March 17th, 1898, being date of application in United States.) (*Complete.*)

21,551. "Improvements in controlling electric motors and electrically-propelled railway trains." E. W. Rice, jun. Dated October 13th. (Date applied for under Patents, &c, Act, 1883, Sec. 103, March 26th, 1898, being date of application in United States.) (*Complete.*)

21,573. "Improvements in dynamo-electric generators, motors, and transformers." C. W. Thompson. Dated October 13th.

21,633. "Improvements in electricity meters." G. Hookham. Dated October 14th.

21,638. "Improvements in arc lamps for projection, and for laboratory or like purposes." J. Stuart and J. H. Barton. Dated October 14th.

21,652. "An improved system of electric traction." S. Worthington and R. J. Crowley. Dated October 14th.

21,689. "Improvements in induction motors." W. L. Davies. Dated October 14th.

21,695. "A circulating electric battery." E. A. Stokes, E. J. Stokes, and R. J. Crowley. Dated October 15th.

21,713. "Improvements in automatic means of breaking electric circuits." J. Ferguson and J. White. Dated October 15th.

21,716. "Improvements in electric measuring instruments." W. Thomson, Baron Kelvin of Largs. Dated October 15th.

21,726. "Improvements in and connected with coin-controlled phonographs." G. V. Gress and W. H. Miller. Dated October 15th. (*Complete*)

21,733. "Tubes and fittings for electrical purposes." H. E. Dolphin. Dated October 15th.

21,752. "Improvements in telescriptors or telegraphic transmitting and recording or receiving apparatus." The Telescriptor Syndicate, Ltd. (B. Hoffmann, France.) Dated October 15th.

21,755. "Improvements in electric meters, parts of which are applicable to the reduction of friction of rotating shafts." B. J. B. Mills. (R. S. White, United States) Dated October 15th. (*Complete.*)

21,759. "Improvements in electric train systems." W. B. Potter. Dated October 15th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, March 31st, 1898, being date of application in the United States.) (*Complete.*)

21,718. "Improvements in electric arc lamps." English Industrials, Ltd. (Elektricitäts Aktiengesellschaft, Germany.) Dated October 15th.

21,719. "Improvements in hand vice and other strainers or stretchers for telegraph, telephone, and other wires." W. S. Mackie. Dated October 15th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free,* 9*d.* (*in stamps*).

1898.

3,805. "Improvements in electrical switch apparatus." T. H. Minshall. Dated June 27th, 1898. Relates to a construction of electrical switch apparatus. It consists of a switch provided with two contact plugs that are removed from both fixed contacts when the circuit has to be broken at the fixed contact connected with the feeding circuit, a shutter is provided enclosing the said contact when the switch plug is withdrawn. 2 claims.

9,070. "Improvements in contact shoes for electric railways." W. M. Brown. Dated April 9th, 1898. A block of wood is secured to any desired part of the frame or truck, a piece of rubber hose extends longitudinally throughout the block of wood. A metal strip is secured to the under side of the hose and adapted to make contact with the contact box; a wire connects the contact strip with the apparatus upon the car. 7 claims.

9,960. "Improvements in or relating to electric meters." A. J. Boult (I. E. G. Cauro). Dated April 30th, 1898. Relates to electrical meters provided with a constant electric field. It consists of a closed coil conducting the electric current, shaped to represent a flat and regular figure, having a number of sides greater than two, and connected to the segments of a commutator, the coil and the commutator are secured together and to a small spindle passing through the centre of the coil and rotating about its own axis. 3 claims.

15,144. "Improvements in electric railways and tramways on a road contact system." N. Flechtenmacher. Dated July 9th, 1898. Relates to an improved system of electric traction wherein one of the rails of the track is formed of a material containing cellulose which does not convey electricity, but is yet sufficiently resistant, such, for example, as papier maché, and is provided at regular distances apart with pieces of soft iron passing through the rail from top to bottom, whilst the vehicle is provided with a device adapted to effect the magnetisation of the pieces of soft iron when passing over the latter, the soft iron being combined with devices designed to feed them with electric current from the line when they are influenced by pieces of magnetised soft iron and with collectors designed to take current thus conveyed to the pieces of soft iron in order to supply the motor of the vehicle. 3 claims.

15,646. "Electrically-operated cloth cutters." N. Garland. Dated July 16th, 1898. Relates to improvements in electrically-operated cloth cutters. It consists of the base plate of the machine, the stem, a motor, a main shaft, the balance crank, and the connecting rod from the balance to the clasp on the knife. The knife has a bottom inclined bevelled sharpened edge and an inclined front edge which meets the front of the bottom edge. The front of the knife is provided with a plurality of serrations. 5 claims.